Christchurch Inventory of Total Emissions

Prepared by NIWA

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CHRISTCHURCH EMISSIONS INVENTORY (R98/20)
REPRINT INCORPORATING ADDITIONS AND CORRECTIONS
JUNE 1998

This report (R98/20) amends and supersedes report no. R97/7 – Christchurch Inventory of Total Emissions. (Also superseded is report R97/5 – Christchurch Inventory of Home Heating and Motor Vehicle Emissions).

Additions and corrections to report R97/7 are as follows:

1. ADDITIONS

(i) Emissions Inventory Report, Context, p1.- Addition of notes (1) and (2).
Note (1) explains contents of the first stage of the emissions inventory (Report R97/5 referred to above and now superseded).
Note (2) references Technical Report R98(1) which incorporates the emissions inventory data contained in this report with monitoring data and identifies reductions required in suspended particulate concentrations to meet the ambient air quality target for this contaminant.

(ii) Table 6.5 Section 6.3 – Aircraft Emissions (p.90) and combined estimated pollutant emissions for various times of a typical winter's day across the total study area including aircraft emissions (pp.91, 92)

This addition discusses the Aircraft Emissions data in Appendix VI. Table 6.5 incorporates Aircraft Emissions with data from Table 6.3 – "Combined estimated pollutant emissions for various times of a typical winter's day across the total study area." (Note: Adjustments have not been made to other tables or sections of the report because of the minor impact of aircraft emissions on the total study area).

2. CORRECTIONS

(i) Section 3.3 (P31)
Deleted – Paras 1 to 3 and Table 3.7. (Explanation: Because of the methodology used for estimating domestic emissions, the statistical analysis applied to the relationship between emissions and domestic heating appliances is not valid in the context presented in the superseded report. The same comment applies to reference to this analysis in the Executive Summary, P3).

(ii) Appendix III – Individual Suburb Results. Fendalton Home Heating, P140 in R97/7 (P143 in R98/20). Table replaced with correct table. (Explanation: Table contained in superseded report R97/7 inadvertently repeated preceding table for Inner City Home Heating. Other data and data analyses not affected).

3. GENERAL

An independent assessment has been undertaken of the statistical reliability of the survey method used for calculating 'Home Heating Methods' and Home Heating Emissions. (Report – C Lamb August 1997). This report indicates that the home heating survey methodology is statistically reliable both for the "total study area" and for the "inner suburb study area". However the report indicates that a high error level exists on a suburb by suburb basis and 'care should be taken in making statistical comparisons between suburbs'. The subsequent use of data from this report for estimating the relative contribution of different sources of suspended particulate emissions to monitored concentrations and reductions required in emissions to meet the ambient air quality target are based on emissions for the "total study area" and "inner suburb study area".

Emissions Inventory Report - Context

This report describes the second stage[1] of an emissions inventory for Christchurch, which is one of several investigations being carried out for the Canterbury Regional Council to assist the development of an air quality management strategy for Christchurch.

The data obtained from the emissions inventory are being integrated with air quality monitoring and meteorological data to:

- model the overall reductions required in emissions to achieve an acceptable level of air quality based on health effects and;
- establish the boundaries of the area within which reductions in emissions are required to achieve the purposes of the Resource Management Act.

Related studies[2] being carried out include investigations of projections for emissions from each major sector; options for the allocation of emission reduction measures among the industrial, transport and domestic sectors; methods for the reduction of emissions within each of the above sectors and associated costs; the potential impact of emissions from the burning of rubbish in the central, suburban, and outer areas of Christchurch City; and surveys of the public perception of nuisance effects associated with emissions from combustion processes.

When the above studies have been completed, a summary report will be prepared integrating the results of each of these studies. This report will address the advantages and disadvantages of different management options (including time-frames) for reducing existing pollution levels and for maintaining acceptable standards of air now and in the future. This and other reports will be used in the preparation of a consultative draft air plan; it will be presented to the public for review and comment in July 1997.

[1] The first stage of the emissions inventory – emissions from domestic fires and motor vehicles – is included in this report

[2] The relationship between emissions inventory data, ambient air quality monitoring data and reductions in suspended particulate concentrations is discussed in Technical Report R98(1), ISBN 1-86937-334-0 "Reductions in Suspended Particulate Concentrations in Christchurch".

Executive Summary

The reliable assessment of the air polluting loads generated by each source, or a group of similar sources, within a study area is essential for the identification of the nature, magnitude and origin of the existing pollution problem, and for the formulation of rational pollution abatement strategies.

This research makes up one of the most detailed studies ever undertaken on the emissions to air of the more important air pollutants across Christchurch. The results are consistent with expectations and with previous studies but several significant new factors have been identified (such as what causes emissions to vary from area to area and the relative contribution to air pollution of home heating, motor vehicles and industry).

Key Results

Methods of Home Heating:

- Multiple methods of home heating occur within the main living area of the same household on a typical winter's day.
- Electricity is used by 68% and 71% of households in the total study area and within the inner suburb study area respectively to heat the main living area on a typical winter's day while 28% and 23% of households use woodburners.
- Across the total study area approximately 13240 households use an open fire on a typical winter's day to heat the main living area. This equates to approximately 14% of the total number of households in the total study area, and nearly 31% of solid fuel burning appliances in use.
- Within the total study area there are approximately 26160 households using woodburners to heat the main living area on a typical winter's day (approximately 28% of the total number of households in the total study area and nearly 61% of solid fuel burning appliances in use).
- 50% of the households that use woodburners, had them installed prior to 1989, approximately 23% were installed between 1989 and 1992 while over 25% have been installed since 1993.

Wood and Coal Use:

- By weight, the use of wood on a typical winter's day within the total study area is approximately four and a half times greater that the use of coal (590 tonnes of wood compared to 132 tonnes of coal). Within the inner suburb area 69 tonnes of coal are burnt per day compared to 288 tonnes of wood.
- Across the total study area approximately 65% of the daily firewood consumption is burnt on woodburners, 31% on open fires, 2% on enclosed coal burners and 1% on incinerators. Nearly 60% of the daily coal consumption is burnt on open fires, 33% on enclosed coal burners, 5% on woodburners, 1% each on incinerators and pot bellies.
- Within the inner suburb study area, 59% of the daily wood consumption is burnt on woodburners compared with 38% on open fires. 64% of the daily coal consumption is burnt on open fires, 29% on enclosed coal burners, 3% on woodburners and 3% on incinerators.

Home Heating Emissions:

- The burning of wood and coal on open fires in the total study area is estimated to produce 48% of the home heating PM_{10} emissions while the burning of wood on woodburners produces 34%. 15% of PM_{10} emissions stem from the burning of wood and coal on enclosed coal burners.
- Within the inner suburb study area, 56% of PM_{10} emissions stem from the burning of wood and coal on open fires, 31% from woodburners, and 12% from enclosed coal burners.

- Across the total study area, open fires are responsible for approximately 43% of CO emissions, 45% of NO_x emissions, 57% of SO_x emissions, 43% of VOC emissions, and 39% of CO_2 emissions. Of those emissions, wood burning on an open fire produces 36% of CO emissions, 33% of NO_x emissions, 1% of SO_x emissions, 36% of VOC emissions, and 23% of CO_2 emissions. Coal burning on an open fire makes up the difference.
- The burning of wood on woodburners across the total study area produces approximately 49% of CO emissions, 45% of NO_x emissions, 4% of SO_x emissions, 49% of VOC emissions, and 49% of CO_2 emissions. Coal burning on woodburners contributes to a small percentage of CO_2 emissions (2%) and to over half of the SO_x emissions (5%).
- Within the inner suburb study area, the burning of wood and coal on an open fires produces 51% of CO emissions, 53% of NO_x emissions, 63% of SO_x emissions, 51% of VOC emissions, and 46% of CO_2 emissions. Of those emissions, wood burning on an open fire produces 43% of CO, 39% of NO_x, 2% of SO_x, 43% of VOC, and 28% of CO_2 emissions. Coal burning on an open fire makes up the difference (61% in the case of SO_x).
- The burning of wood and coal on woodburners produces approximately 43% of CO emissions, 39% of NO_x emissions, 6% of SO_x emissions, 43% of VOC emissions, and 44% of CO_2 emissions. Coal burning on woodburners contributes to a small percentage of CO_2 emissions (1%) and to half of the SO_x emissions (3%).
- Across the total study area, 32% of SO_x, 7% of NO_x, 9% of CO_2 comes from the burning of coal on enclosed coal burners. Within the inner suburb study area, 28% of SO_x, 6% of NO_x, 8% of CO_2 comes from the coal burning on these appliances.
- At the 95% confidence level, PM_{10} emissions are positively correlated with the use of open fires and to the use of enclosed coal burners. The relationship between PM_{10} and woodburners is significant at the 99% confidence level. CO is positively correlated to open fires and to woodburners at the 99% confidence level. SO_x emissions are positively correlated with the use of open fires, oil fires, pot bellies, and gas at the 95% confidence level and are correlated with the use of enclosed coal burners at the 99% confidence level
- The total study area is estimated to produce approximately 10971 kilograms of PM_{10} per day or 618 gram per hectare per day whereas the inner suburb study area is estimated to produce 51% of the total PM_{10} emissions (5585 kg/day). On a grams per hectare basis, the PM_{10} emissions from home heating within the inner suburb study area are 1.5 times greater than the total study area (928 g/ha/day compared to 618 g/ha/day).
- The inner suburb study area is estimated to produce 50% of the total CO, NO_x, VOC, and CO_2 emissions and 52% of the total SO_x. On a grams per hectare basis, the inner suburb study area produces 1.5 times more CO, NO_x, SO_x, VOC, and CO_2 than the total study area.
- On an individual suburb basis, PM_{10} emissions per hectare in Burnside/Bryndwr can be as much as 41 times larger than those in New Avonhead. CO and NO_x can be as much as 30 times larger, VOC 28 times larger, CO_2 20 times larger, and SO_x 450 times greater.
- Across the total study area, ~78% of PM_{10}, CO, NO_x, SO_x, VOC, and CO_2 are emitted between 4pm and 6am on a typical winter's night. The next highest period of emissions occurs between 10am and 4pm across all pollutants (15% of each pollutant released during this time).
- Within the inner suburb study area, ~80% of pollutants are emitted between 4pm and 6am on a typical winter's night. The next highest period of emissions occurs from 10am to 4pm across all pollutants (with 12%-14% released during this time).
- Both in the total study area and the inner suburb study area estimated PM_{10}, CO, NO_x, SO_x, VOC, and CO_2 emissions are lowest between the hours of 6am and 10am when ~7% of the total daily emissions are released

Motor Vehicle Emissions:

- Suburbs with larger vehicle kilometers travelled (VKT) values and more major traffic routes display higher emissions of the six pollutants than suburbs with lower VKT's values.
- Light duty petrol vehicles are the main emitters of CO (~90%), VOC (83%), and CO_2 (~70%). Heavy duty diesel vehicles tend to emit larger quantities of PM_{10} (65%) and SO_x (87%). A further 20% of CO_2 emissions stem from heavy duty diesel vehicles while nearly 30% of PM_{10} emissions are derived from light duty petrol vehicles. Both light duty petrol vehicles and heavy duty diesel vehicles release similar quantities of NO_x (50% and 46% respectively).
- On average, the inner suburb area produces 1.5-1.75 times the amount of all six pollutants per hectare per day when compared to the quantities produced by the total study area.
- The total study area is estimated to produce approximately 1365 kilograms of PM_{10} per day or 77 gram per hectare per day from motor vehicles whereas the inner suburb study area is estimated to produce 55% of the total PM_{10} emissions (747 kg/day). On a grams per hectare basis, the PM_{10} emissions from motor vehicles within the inner suburb study area are 1.6 times greater than the total study area (124 g/ha/day compared to 77 g/ha/day).
- The inner suburb study area is estimated to produce nearly 60% of the total CO and NO_x emissions from motor vehicles, 54% of the total SO_x and CO_2 emissions and 51% of the total NO_x emissions. On a grams per hectare basis, the inner suburb study area produces 1.5 times more NO_x than the total study area, 1.6 times the SO_x and CO_2, and 1.7 times the CO and VOC.
- On an individual suburb basis, PM_{10} emissions per hectare in the Inner City are approximately 230 times larger than those in New Avonhead. CO and CO_2 can be as much as 350 times larger, NO_x and VOC 340 times larger, and SO_x 190 times greater.
- On average, approximately 45% of all motor vehicle emissions of PM_{10}, CO, NO_x, SO_x, VOC and CO_2 are released between the hours of 10am-4pm across the total study area. A secondary peak occurs between 4pm-10pm, during which ~30% of contaminants are emitted. A further 22% of pollutants are emitted between 6am-10am. Only 4-5% of all pollutants are emitted overnight (between 10pm-6am). This pattern is also a similar feature of the inner suburb area across all six pollutants, as well as in the majority of individual suburbs.
- The average estimated emissions per hectare from motor vehicles within the inner suburb area are 1.5-1.75 times the emissions of the total study area for all six pollutants.

Industrial Emissions:

- Across the total study area, Part A industries are the main emitters of PM_{10} (44%) and VOC (47%), while Part B industries emit larger quantities of CO (50%), NO_x (40%), and SO_x (39%). Part C industries emit nearly half the CO_2 (46%).
- Within the inner suburb study area, Part A industries are the main emitters of PM_{10} (46%), while Part B industries emit larger quantities of CO (37%), NO_x (37%), and SO_x (39%). Part C industries emit approximately 80% of VOC and over half the CO_2 (51%).
- On average, Part A industries within the inner suburb area produce approximately half of the kilogram per day figure for all pollutants except VOC (which produces approximately 20 times more per day). However on a per hectare basis, the inner suburb study area produces 1.6 times more PM_{10} per hectare than the total study area, 1.7 times the CO_2, 1.8 times the CO and NO_x and 1.3 times the SO_x. The total study area however, produces 7 times more VOC than the inner suburb study area.
- On a kilogram per day basis, Part B industries within the inner suburb area emit 40%-50% of the kg/day figure, yet on a per hectare basis they produce 1.3 times more PM_{10} and CO_2 than the total study area, 1.5 times the NO_x and SO_x, 1.2 times the VOC, and equal quantities of CO.
- Part C industries within the inner suburb area produce 1.8 times more PM_{10} per hectare than the total study area, 1.7 times the NO_x and SO_x, 1.9 times the VOC and CO, and 1.1 times the

quantities of CO_2. On a kilogram per day basis they produce approximately half to a third of the total study area.

- The total study area is estimated to produce approximately 1018 kilograms of PM_{10} per day or 57 grams per hectare per day whereas the inner suburb study area is estimated to produce half the total PM_{10} emissions (512 kg/day). On a grams per hectare basis, the PM_{10} emissions from industry within the inner suburb study area are 1.5 times greater than the total study area (85 g/ha/day compared to 57 g/ha/day).
- The inner suburb study area is estimated to produce nearly 50% of the total CO emissions, ~55% of the total NO_x and CO_2 emissions, 51% of the total SO_x emissions, and 35% of the VOC emissions. On a grams per hectare basis, the inner suburb study area produces 1.4 times more CO than the total study area, 1.6 times the NO_x and CO_2, and 1.5 times the SO_x. VOC emissions per hectare are the same in both the total study area and the inner suburb study area.
- On an individual suburb basis, industrial emissions vary considerably from suburb to suburb. For example, when comparing the suburb of Racecourse with the Inner, PM_{10} emissions per hectare in the Inner City are approximately 450 times larger than those in the Racecourse. CO_2 can be as much as 350000 times larger, NO_x nearly 900 times larger, SO_x 1700 times greater, CO and VOC around 200 times larger.
- Pollutant concentrations are largely determined by the number and type of industries within a study area. Suburb areas with few or no industries tend to exhibit lower pollutant emissions per day whereas suburbs with a larger number of industries displayed higher pollutant concentrations.
- Across the total study area, ~40% of PM_{10}, CO, NO_x, and SO_x, and ~45% of VOC and CO_2 are released between the hours of 10am and 4pm on a typical winter's day. The remaining emissions are evenly spread between the three other time periods.
- Within the inner suburb study area, 34% to 39% of PM_{10}, CO, NO_x, and SO_x, 60% of VOC and 46% of CO_2 emissions are released between the hours of 10am and 4pm on a typical winter's day. With the exception of VOC, the remaining emissions are evenly spread between the three other time periods. For VOC, 25% of the emissions are released between 6am and 10am while 14% are emitted from 4pm to 10pm. 1% of VOC emissions are released from 10pm and 6am.
- On an individual suburb basis, PM_{10}, CO, NO_x, SO_x, VOC, and CO_2 emissions tended to peaked between the hours of 4pm and 10pm. In the suburbs where the peak was not between 4pm and 10pm, it occurred between 10pm an 6am.
- In ~70% of the suburbs, the next highest period of PM_{10}, CO, NO_x, SO_x, and CO_2 emissions occurred between 6am and 10am. For VOC, ~85% of the suburbs also displayed a secondary peak between 6am and 10am. Low PM_{10}, CO, and SO_x emissions were displayed between 10pm and 6am in ~75% of the suburbs. Over 80% of the suburbs displayed low NOx, CO2, and VOC between 10pm and 6am.

Combined Emissions:

- In the total study area and the inner suburb study area, 82% of PM_{10} emissions to the air on a typical winter's day result from domestic solid fuel heating. Approximately 90% of nitrogen oxide emissions, ~65%-70% of CO and VOC, and nearly 60% of CO_2 emissions are derived from motor vehicles. Almost 50% of SO_x emissions stem from industry and a further third is derived from home heating.
- In 96% of the suburbs, more PM_{10} emissions to the air on a typical winter's day result from domestic solid fuel heating than from motor vehicles or industry. Motor vehicles emit more CO, NO_x, VOC, and CO_2 than home heating or industry in 80%, 96%, 76%, and 88% of the suburbs respectively. In 13 of the 25 suburbs (52%), more SO_x is emitted from home heating than from motor vehicles or industry.
- Across the total study area, combined home heating, motor vehicle and industrial PM_{10}, CO, SO_x, VOC, and CO_2 emissions peak between the hours of 4pm-10pm. Combined NO_x emissions peak between 10am and 4pm. Combined PM_{10} emissions are at their lowest between 6am-10am while combined CO, NO_x, SO_x, VOC and CO_2 emissions drop off between 10pm-6am.

- Within the inner suburb study area, combined PM_{10} emissions are at their lowest between the hours of 6am and 10am. All other pollutants are at their lowest between 10pm and 6am. Combined PM_{10}, CO, SO_x, VOC and CO_2 emissions all peak between 4pm and 10pm. Combined NO_x peaks between 10am and 4pm.
- Across the individual suburbs, combined motor vehicle, solid fuel heating and industrial PM_{10}, CO, SO_x and VOC emissions peak between the hours of 4pm-10pm in over 60% of suburbs. Furthermore, for PM_{10} the peak period between 4pm and 10pm is recorded in all suburbs but the Airport (96%). Combined CO_2 emissions peak between 4pm and 10pm in 56% of the suburbs while NO_x peaks between 10am and 4pm in all suburbs. Combined CO, NO_x, VOC and CO_2 emissions drop off between 10pm-6am in over 85% of the suburbs. 60% of the suburbs record the low period for SO_x between 10pm and 6am while 40% record it between 6am-10am. For PM_{10} the low period for emissions is almost even between 6am-10am and 10pm-6am in 52% and 48% of the suburbs respectively.

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1. Introduction

1.1. Purpose of Study

The main objective of the Christchurch emissions inventory is to provide information on various emission sources across the main urban and industrial areas of Christchurch. This information will then be used to develop management strategies to reduce present contaminant concentrations in the ambient air which exceed acceptable levels, and provide for longer-term management of air contaminants within acceptable concentrations.

Data collected from the St Albans monitoring site since 1988 indicates that the majority of Christchurch's air pollution problems occur over the winter months (from May-August) between the hours of 4pm and midnight (Figure 1.1 and Figure 1.2 with Figure 1.2 as an example of high pollution days in 1995). High pollution days are characterised by still clear days and frosty nights. Under these conditions, temperature inversions tend to form over the city in the evenings, thus trapping air and pollutants underneath. The problem is further compounded over the winter months by increased solid fuel burning for domestic home heating (especially in the evenings).

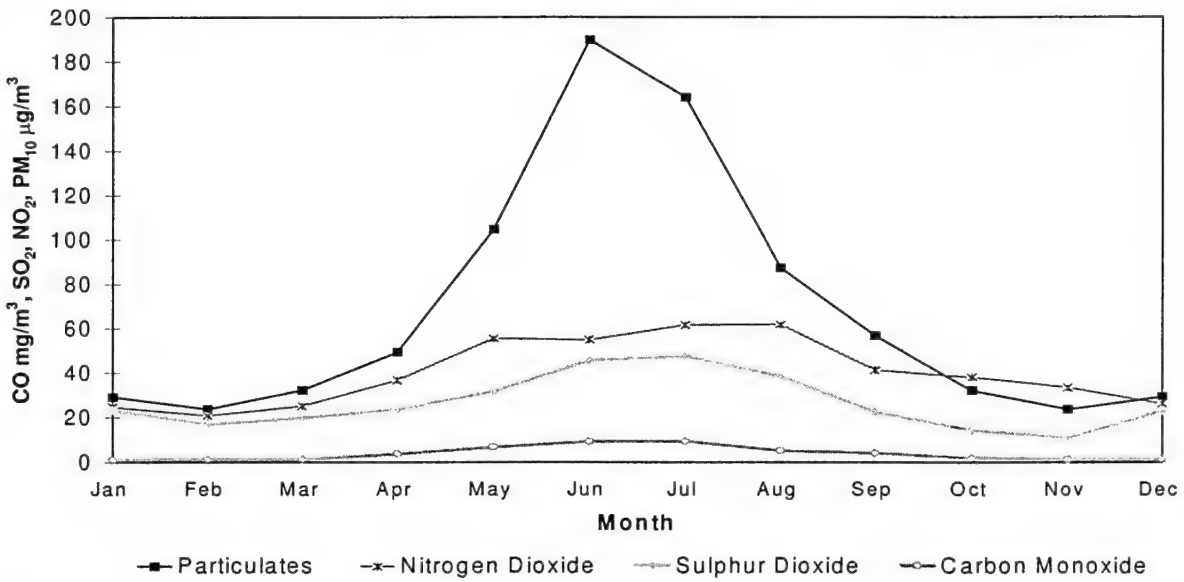

Figure 1.1 Maximum 24 hour concentrations of PM_{10}, NO_2, SO_2 and CO, averaged monthly for the years 1988-1996 at St Albans monitoring site.

The contaminants of immediate concern are fine particulates (PM_{10}) and carbon monoxide (CO). Under "worst case" conditions on a high pollution night, PM_{10} levels have reached as high as 700µg/m^3 over a two-hour period (compared to a 24-hour national ambient air quality guideline of 120 µg/m^3). However, other contaminants that also require addressing are nitrogen oxides (NO_x), sulphur oxides (SO_x), carbon dioxide (CO_2) and volatile organic compounds (VOCs).

Previous research conducted in Christchurch (Brady and Pullen, 1985) identify domestic fires and motor vehicles as significant sources of the above emissions during temperature inversion conditions. However, from the air quality management perspective more detailed information is required on the relative contribution from various sources at different periods of the day, including times of likely temperature inversion.

To assess the impact of potential management options on various methods of domestic heating, information is also required on the use of wood, coal, oil, gas and electricity, and any variations in the use of these energy sources in different areas of the city relative to different types and age of residential development.

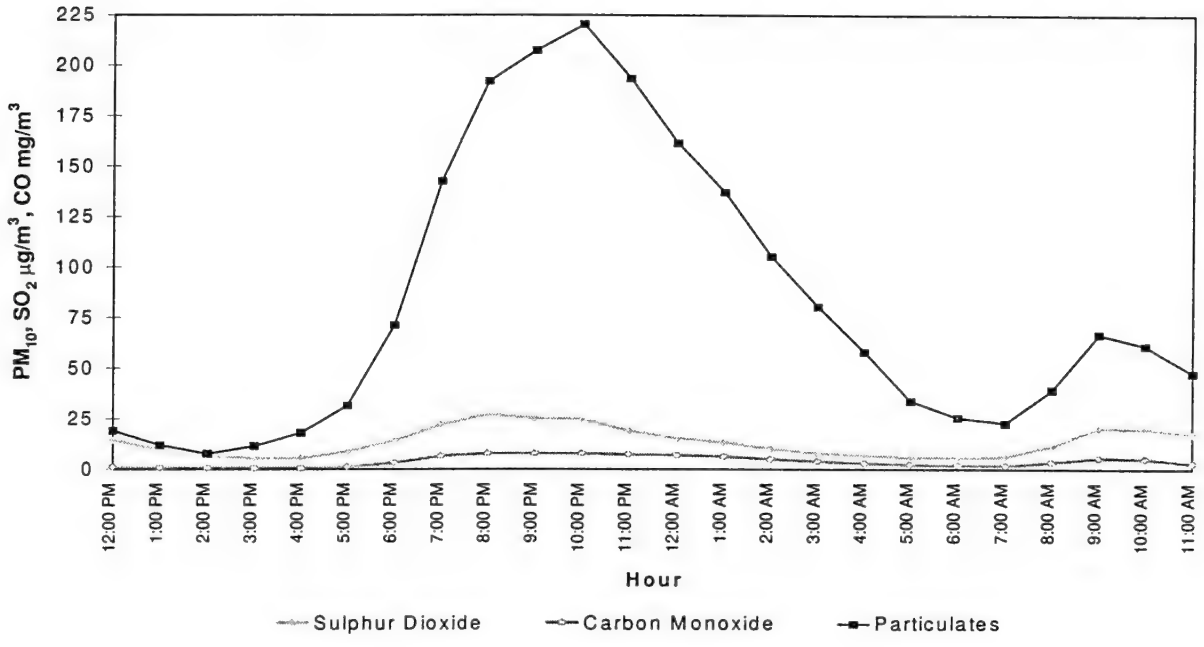

Figure 1.2 Typical average hourly concentrations of SO_2, CO and PM_{10} on high pollution days in 1995 at St Albans.

To gather all the necessary information, this study has been designed to examine:

- Variations in emissions from home heating on a suburb-by-suburb basis for subsequent integration with emissions from motor vehicles and industrial processes.
- Typical winter's day emissions resulting from the burning of wood and coal on the various solid fuel-burning appliances in use for domestic heating.
- Variations in home heating emissions from solid fuel burning for different time periods during the day.
- Variations in different methods of home heating and in fuel use (including sources of wood fuel) for different areas of the city.
- Variations in exhaust emissions from motor vehicles on a suburb-by-suburb basis for subsequent integration with emissions from home heating and industrial processes.
- Typical winter's day exhaust emissions from motor vehicles for different classes of diesel and petrol-fuelled vehicles.
- Variations in motor vehicle emissions for different time periods during the day.
- Variations in industrial emissions on a suburb-by-suburb basis for subsequent integration with emissions from home heating and motor vehicles.
- Typical winter's day emissions from different industry types.
- Variations in industrial emissions for different time periods during the day.

This information will then be used to:

- compare estimated pollutant concentrations to actual monitored pollutant levels;
- identify the relative contribution of the emissions from various sources;
- examine the possible effect of various management scenarios to reduce pollutant concentrations and;
- aid in the maintenance of future air quality at an acceptable level.

1.2. What Suburb Areas were Studied?

Between June 1995 and June 1996, over 800 Christchurch households were surveyed about their home space heating habits. In order to assess the relative contributions of motor vehicles and industry to home heating, information on traffic density and industry operation were required. VKT (vehicle kilometres travelled) data were obtained for all twenty-five suburb areas of Christchurch from CRC - Transport. Christchurch industry information was gathered from CRC resource consent records and survey questionnaires of Part A and B industries. From all of this information, particulate (PM_{10}), carbon monoxide (CO), nitrogen oxide (NO_x), sulphur oxide (SO_x) volatile organic compounds (VOC) and carbon dioxide (CO_2) emissions to the air from home heating appliances, motor vehicles and industry were estimated for a typical winter's day.

The home space heating surveys were primarily conducted in Parklands, Fendalton, New Brighton, Shirley, Burnside/Bryndwr, Avonhead, St Albans, New Avonhead, Riccarton, Spreydon/Addington, Opawa/Woolston, Linwood, Hornby, Hoon Hay, Beckenham/Sydenham, and the Inner City. For the remaining suburbs (Redwood, Bishopdale, Wigram, Sockburn, Redwood, Marshlands, Addington Industrial, Airport, Bishopdale, Bromley and the Racecourse), estimates were made based on demographic factors and on similarities between unsurveyed and surveyed areas.

The various study areas are shown in Figure 1.3, and their sampling details presented in Table 1.1. Suburb boundaries are identified on a 1991 census map contained in Appendix I. Survey questionnaires can be found in Appendix II.

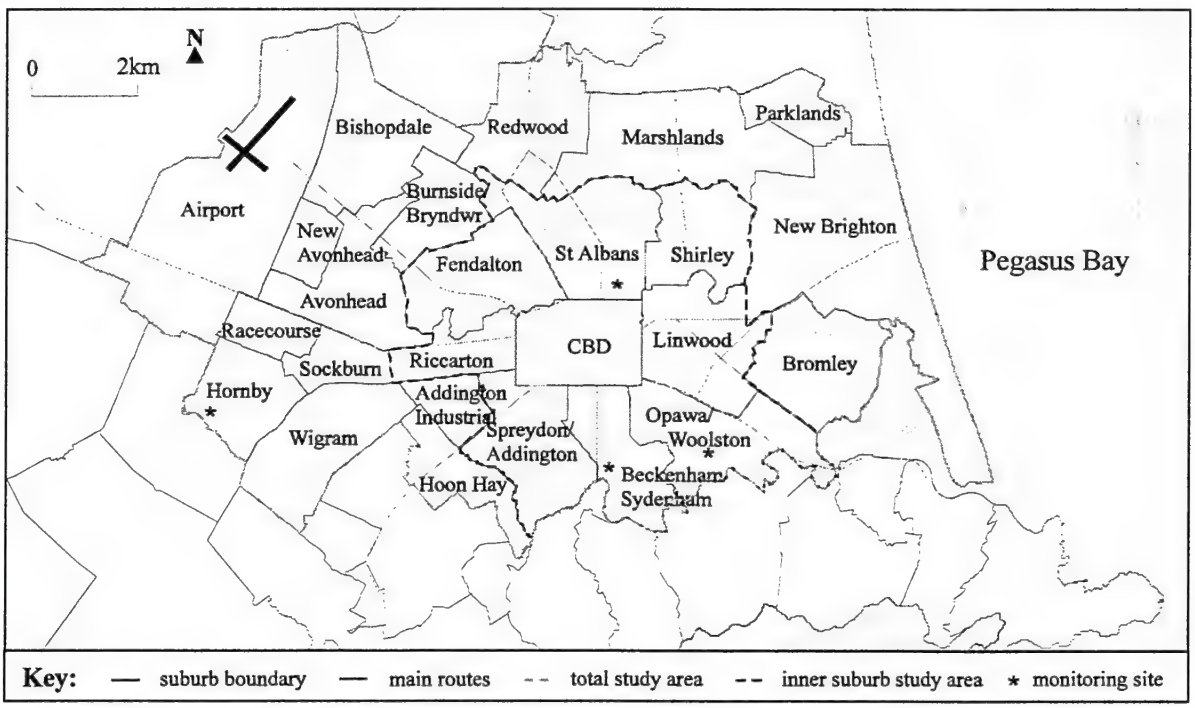

Figure 1.3 Map showing the location of the various study areas across Christchurch.

Information was collected on a suburb-by-suburb basis so that variations in emission sources and methods of home heating could be identified. Results were also grouped into two additional areas (the total study area and the inner suburb study area). These two larger study areas have been included to provide a more representative basis for the comparison of emissions and monitored air quality than that available on an individual suburb basis.

Table 1.1 Sampling details of the various study areas across Christchurch.

Suburb Area	Area (ha)	Total Number of Households	Housing Density (houses/ha)	Total Households Surveyed	Household Survey Method	Average Daily VKT (km)	Number of Industries
Inner Suburbs							
Beckenham/Sydenham	555	4551	8	50	phone	409153	6
Fendalton	745	6033	8	46	door	336525	13
Inner City	635	2715	4	50	phone	741166	156
Linwood	754	8364	11	50	phone	490425	20
Opawa/Woolston	798	4380	5	50	phone	414450	47
Riccarton	349	3309	9	50	phone	318300	9
Shirley	572	4377	8	68	door	200837	11
Spreydon/Addington	745	6744	9	50	phone	414892	28
St Albans	864	9948	12	40	door	443360	21
Sub-total - Inner Suburb Study Area	6016	50421	8	454		3769108	311
Outer Suburbs							
Addington Industrial[SD]	230	273	1	-	estimate	124767	7
Airport[AV]	2088	198	0	-	estimate	223749	9
Avonhead	727	6315	9	50	phone	512839	15
Bishopdale[SA]	887	3453	4	-	estimate	164128	22
Bromley[NB]	764	930	1	-	estimate	172335	47
Burnside/Bryndwr	460	4808	10	50	phone	200212	2
Hoon Hay	421	3144	7	50	phone	176651	10
Hornby	498	2679	5	50	phone	180516	32
Marshlands[BK]	1135	1254	1	-	estimate	262311	8
New Avonhead	230	777	3	43	door	773	3
New Brighton	1942	11520	6	50	phone	430819	29
Parklands	312	1572	5	54	door	58669	6
Racecourse[HB]	247	717	3	-	estimate	34232	0
Redwood[BK]	752	4533	6	-	estimate	259875	17
Sockburn[HB]	264	1812	7	-	estimate	202527	13
Wigram[HB]	786	450	1	-	estimate	247019	35
Sub-total	11741	44435	4	347		3251422	254
Total - Total Study Area	17757	94856	5	801		7020530	565

[AV] Based on Avonhead results
[BK] Based on Beckenham results
[HB] Based on Hornby results
[NB] Based on New Brighton results
[SA] Based on St Albans results
[SD] Based on Spreydon/Addington results

Note: % Sampled = (Sampled No.of Households ÷ Total No.of Households) x 100%

The body of this report consists of six main sections. The first section (Section 2) examines various methods of domestic space heating used in households across Christchurch. The results of home heating, motor vehicle, and industrial emissions for a typical winter's day, and for various times of the day, are addressed in Sections 3, 4 and 5 respectively.

Within Section 6, home heating, motor vehicle and industrial emissions are combined and results presented for a typical winter's day and for various times of the day. Finally, key results are outlined in Section 7.

2. Home Heating Methods

2.1. Appliance Use

The breakdown of home heating methods used by households within the total study area, the inner suburb study area and across the individual suburbs are provided in Table 2.1 over.

These figures (Table 2.1) do not include households which, at the time of the survey may have used solid fuel burning appliances 'occasionally' or which used solid fuel burning appliances to heat other areas of the dwelling. (Multiple methods of home heating, and the time of day of appliance use, are taken into account in calculating emissions.)

Survey results indicate that multiple methods of home heating occur within the main living area of the same household on a typical winter's day. This occurs both for the use of gas and electricity (some heater models are combined gas/electricity) and for the use of solid fuel burning appliances together with gas or electricity, and also with other solid fuel burning appliances. Therefore, while many households use non or low polluting methods of home heating, such as electricity or gas, many of the households also use an open fire, woodburner, or other solid fuel burning appliance in the main living area. Results also indicate that some households use multiple solid fuel burning appliances within the main living area on a typical winter's day. For example this is reflected in differences between tables 2.1 and 2.2.

The suburbs with the greatest percentage of households using solid fuel burning appliances are Burnside/Bryndwr and Hoon Hay (64%), followed by St Albans, Spreydon/Addington, Addington Industrial, Bromley, New Brighton, Hornby, Sockburn, Racecourse, and Wigram (52% - 58%) (Table 2.1). The suburb with the lowest percentage of households using solid fuel burning appliances is New Avonhead (9%) followed by Beckenham/Sydenham, Marshlands, Redwood, Airport and Avonhead at 24%. Suburbs which fall between the two above extremes are Fendalton, Shirley, Riccarton, Inner City, Bishopdale, Linwood, Opawa/Woolston and Parklands (32% - 46%).

Across the total study area, approximately 13240 households use an open fire on a typical winter's day to heat the main living area. This equates to approximately 14% of the total number of households in the total study area, and nearly 31% of solid fuel burning appliances in use (Table 2.1).

The suburbs with the greatest percentage of households using open fires on a typical winter's day to heat the main living area are Fendalton and the Inner City (28%), followed by St Albans (23%), Addington Industrial (22%) and Spreydon/Addington (20%). No households in New Avonhead use an open fire. 2% of the households in Parklands, Airport and Avonhead use an open fire. Suburbs which fall between are Beckenham/Sydenham, Linwood, Opawa/Woolston, Riccarton, Shirley, Bishopdale, Bromley, Burnside/Bryndwr, Hoon Hay, Hornby, Marshlands, New Brighton, Racecourse, Redwood, Sockburn and Wigram (6% - 18% of households).

Across the total study area there are approximately 26160 households using woodburners to heat the main living area on a typical winter's day (28% of the total number of households in the total study area and nearly 61% of solid fuel burning appliances in use) (Table 2.1). Approximately half of these appliances were installed before the upgrade of 'approval criteria' for solid fuel burning appliances in 1988. 23% of the appliances were installed between 1989 and 1992 and over 25% have been installed since 1993 (Figure 2.1).

The age distribution of pre 1988 appliances across the individual suburb areas range between 38% (Parklands) and 63% (Riccarton) (Table 2.3). An exception to this is Addington Industrial where 20% of woodburners were installed before 1988. In approximately 70% of the suburbs, between 50% and 60% of the woodburners were installed before 1988, while 40% to 50% were installed after 1988.

Table 2.1 Methods of home heating across various study areas of Christchurch.

Suburb Area	Total Number of Households	Electricity		Gas (LPG)		Oil fire		Open fire/Visor		Woodburner		Enclosed Coal Burner		Pot Belly		Incinerator	
		Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Inner Suburb Study Area																	
Beckenham/Sydenham	4551	3277	72	1183	26	182	4	546	12	546	12	0	0	0	0	0	0
Fendalton	6033	4984	83	393	7	131	2	1705	28	1180	20	131	2	0	0	0	0
Inner City	2715	2172	80	652	24	0	0	760	28	272	10	0	0	0	0	0	0
Linwood	8364	5855	70	1506	18	502	6	1004	12	1338	16	335	4	0	0	0	0
Opawa/Woolston	4380	3066	70	964	22	175	4	526	12	1402	32	88	2	0	0	175	4
Riccarton	3309	2713	82	132	4	132	4	463	14	529	16	66	2	0	0	0	0
Shirley	4377	3540	81	257	6	0	0	257	6	1352	31	64	1	0	0	322	7
Spreydon/Addington	6744	3912	58	1484	22	540	8	1349	20	1619	24	674	10	0	0	0	0
St Albans	9948	6218	63	995	10	0	0	2238	23	3482	35	0	0	0	0	0	0
Sub-total - Inner Suburb Study Area	50421	35736	71	7566	15	1662	3	8848	18	11719	23	1358	3	0	0	497	1
Outer Suburbs																	
Addington Industrial	273	158	58	60	22	22	8	60	22	60	22	27	10	0	0	0	0
Airport	198	170	86	28	14	24	12	4	2	28	14	12	6	4	2	0	0
Avonhead	6315	5431	86	884	14	758	12	126	2	884	14	379	6	126	2	0	0
Bishopdale	3453	1727	50	276	8	0	0	622	18	967	28	0	0	0	0	0	0
Bromley	930	539	58	167	18	74	8	74	8	428	46	19	2	0	0	0	0
Burnside/Bryndwr	4808	3077	64	673	14	192	4	865	18	1923	40	288	6	0	0	0	0
Hoon Hay	3144	1446	46	755	24	63	2	314	10	1698	54	0	0	0	0	0	0
Hornby	2679	1661	62	804	30	214	8	321	12	911	34	214	8	54	2	0	0
Marshlands	1254	903	72	326	26	50	4	150	12	150	12	0	0	0	0	0	0
New Avonhead	777	723	93	126	16	0	0	0	0	72	9	0	0	0	0	0	0
New Brighton	11520	6682	58	2074	18	922	8	922	8	5299	46	230	2	0	0	0	0
Parklands	1572	844	54	233	15	0	0	29	2	466	30	58	4	0	0	0	0
Racecourse	717	445	62	215	30	57	8	86	12	244	34	57	8	14	2	0	0
Redwood	4533	3264	72	1179	26	181	4	544	12	544	12	0	0	0	0	0	0
Sockburn	1812	1123	62	544	30	145	8	217	12	616	34	145	8	36	2	0	0
Wigram	450	279	62	135	30	36	8	54	12	153	34	36	8	9	2	0	0
Sub-total	44435	28472	64	8478	19	2739	6	4390	10	14443	33	1466	3	243	1	0	0
Total - Total Study Area	94856	64208	68	16044	17	4401	5	13239	14	26162	28	2825	3	243	0	497	1

NB The number of households with solid fuel burning appliances can be found in Table 2.2. It is not appropriate to add the heating method totals in this table as multiple methods of home heating can be used within the same household.

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Table 2.2 Number and percentage of **households** using electricity or gas, solid fuel burners (open fires/visors, woodburners, enclosed coal burners, pot bellies, incinerators), and oil burners across various study areas of Christchurch.

Suburb Area	Total Number of Households	Electricity or Gas		Solid Fuel Burners		Oil Burners	
		Number	%	Number	%	Number	%
Inner Suburb Study Area							
Beckenham/Sydenham	4551	4005	88	1092	24	182	4
Fendalton	6033	5115	85	2623	43	131	2
Inner City	2715	2552	94	1032	38	0	0
Linwood	8364	6691	80	2676	32	502	6
Opawa/Woolston	4380	3679	84	1927	44	175	4
Riccarton	3309	2780	84	1059	32	132	4
Shirley	4377	3540	81	1931	44	0	0
Spreydon/Addington	6744	5125	76	3507	52	540	8
St Albans	9948	6466	65	5720	58	0	0
Sub-total - Inner Suburb Study Area	50421	39954	79	21568	43	1662	3
Outer Suburbs							
Addington Industrial	273	207	76	142	52	22	8
Airport	198	182	92	48	24	24	12
Avonhead	6315	5810	92	1516	24	758	12
Bishopdale	3453	1796	52	1588	46	0	0
Bromley	930	688	74	521	56	74	8
Burnside/Bryndwr	4808	3558	74	3077	64	192	4
Hoon Hay	3144	1886	60	2012	64	63	2
Hornby	2679	1982	74	1500	56	214	8
Marshlands	1254	1104	88	301	24	50	4
New Avonhead	777	741	95	72	9	0	0
New Brighton	11520	8525	74	6451	56	922	8
Parklands	1572	1048	67	553	35	0	0
Racecourse	717	531	74	402	56	57	8
Redwood	4533	3989	88	1088	24	181	4
Sockburn	1812	1341	74	1015	56	145	8
Wigram	450	333	74	252	56	36	8
Sub-total	44435	33721	76	20537	46	2739	6
Total - Total Study Area	94856	73674	78	42105	44	4401	5

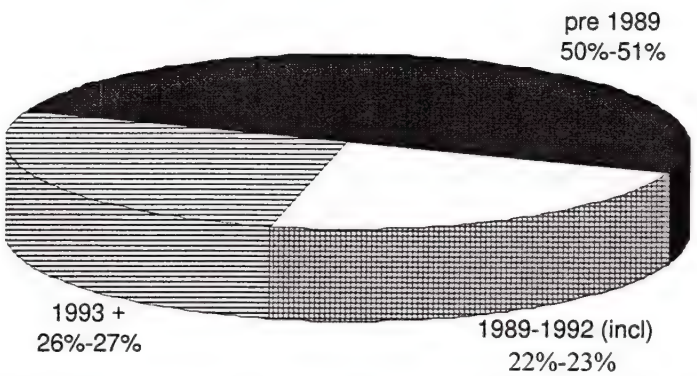


Figure 2.1 Woodburner age breakdown for the total study area and the inner suburb study areas.

Table 2.3 Differences in age of woodburners by suburb.

Suburb Area	Total Number of Households using a Woodburner	Pre 1989 Woodburner		1989-1992 Woodburner (incl)		Post 1993 Woodburner	
		Households		Households		Households	
		Number	%	Number	%	Number	%
Inner Suburb Study Area							
Beckenham/Sydenham	546	273	50	91	17	182	33
Fendalton	1180	525	44	262	22	393	33
Inner City	272	109	40	54	20	109	40
Linwood	1338	669	50	335	25	335	25
Opawa/Woolston	1402	701	50	350	25	350	25
Riccarton	529	331	63	66	13	132	25
Shirley	1352	708	52	322	24	322	24
Spreydon/Addington	1619	809	50	405	25	405	25
St Albans	3482	1741	50	746	21	995	29
Sub-total - Inner Suburb Study Area	11719	5865	50	2631	22	3223	27
Outer Suburbs							
Addington Industrial	60	11	18	27	45	22	36
Airport	28	12	43	4	14	12	43
Avonhead	884	505	57	126	14	253	29
Bishopdale	967	552	57	207	21	207	21
Bromley	428	223	52	93	22	112	26
Burnside/Bryndwr	1923	1058	55	385	20	481	25
Hoon Hay	1698	943	56	377	22	377	22
Hornby	911	536	59	214	24	161	18
Marshlands	150	75	50	25	17	50	33
New Avonhead	72	36	50	18	25	18	25
New Brighton	5299	2534	48	1382	26	1382	26
Parklands	466	175	38	146	31	146	31
Racecourse	244	115	47	57	24	72	29
Redwood	544	272	50	91	17	181	33
Sockburn	616	362	59	109	18	145	24
Wigram	153	72	47	27	18	54	35
Sub-total	14443	7482	52	3289	23	3672	25
Total - Total Study Area	26162	13347	51	5920	23	6895	26

In addition to open fires and woodburners, there are 2825 households across the total study area using enclosed coal burners to heat the main living area on a typical winter's day , 243 households using pot bellies, and 497 households using incinerators. This equates to 3%, under 1% and 1% of the total number of households in the total study area respectively, and to 6.5%. 0.6%, and 1% of solid fuel burning appliances in use respectively (Table 2.1).

Newer suburbs, such as New Avonhead, tend to use electricity and have more modern woodburners, primarily because open fire installations are no longer permitted in Christchurch. With regard to the other suburbs, it is difficult to determine if the variation in solid fuel burning appliance use is related to the average age of the dwellings.

2.2. Wood and Coal Consumption

Wood and coal consumption for the total study area and the inner suburb study area, and their use on different types of solid fuel burning appliances, are contained in Table 2.4 below.

Table 2.4 Wood and coal consumption by appliance type for the total study area and the inner suburb study area.

Appliance & Fuel	Daily Fuel Quantity Total Study Area			Daily Fuel Quantity Inner Suburb Study Area		
	kg/day	t/day	% of Fuel Use	kg/day	t/day	% of Fuel Use
Open fire						
- Wood	184754	184.8	31	110619	110.6	38
- Coal	77112	77.1	59	43832	43.8	64
Pre 1989 Woodburner						
- Wood	198421	198.4	33	86387	86.4	30
- Coal	2935	2.9	2	1012	1.0	1
1989-1992 (incl) Woodburner						
- Wood	88400	88.4	15	38734	38.7	13
- Coal	186	0.2	0	0	0.0	0
Post 1992 Woodburner						
- Wood	101708	101.7	17	46886	46.9	16
- Coal	4427	4.4	3	1642	1.6	2
Enclosed Coal Burner						
- Wood	14113	14.1	2	2752	2.8	1
- Coal	43866	43.9	33	20232	20.2	29
Pot Belly						
- Wood	2495	2.5	0	0	0.0	0
- Coal	1303	1.3	1	0	0.0	0
Incinerator						
- Wood	2418	2.4	0	2418	2.4	1
- Coal	1931	1.9	1	1931	1.9	3
Total Wood	592310	592.3	82	287796	287.8	81
Total Coal	131760	131.8	18	68649	68.6	19
Total Gas	45461	45.5		21226	21.2	
Total Oil	12343	12.3		10058	10.1	
Total (Wood and Coal only)	724069	724		356445	356	

By weight, the use of wood on a typical winter's day within the total study area is approximately four and a half times greater than the use of coal (590 tonnes of wood compared to 132 tonnes of coal). Within the inner suburb area, ~69 tonnes of coal are burnt per day compared to 288 tonnes of wood (Table 2.4).

59% of the daily coal consumption within the total study area is burnt on open fires and 33% on enclosed coal burners. 5% of the daily coal consumption is burnt on woodburners, 1% each on incinerators and pot bellies. 65% of the daily firewood consumption is burnt on woodburners, 31% on open fires, 2% on enclosed coal burners, and less than 1% on incinerators and pot bellies (Table 2.4 and Figure 2.2).

Within the inner suburb study area, 59% of the daily wood consumption is burnt on woodburners compared with 38% on open fires. 64% of the daily coal consumption is burnt on open fires, 29% on enclosed coal burners, 3% on woodburners and 3% on incinerators. Survey results indicate that no wood or coal is burnt on pot bellies (Table 2.4 and Figure 2.3).

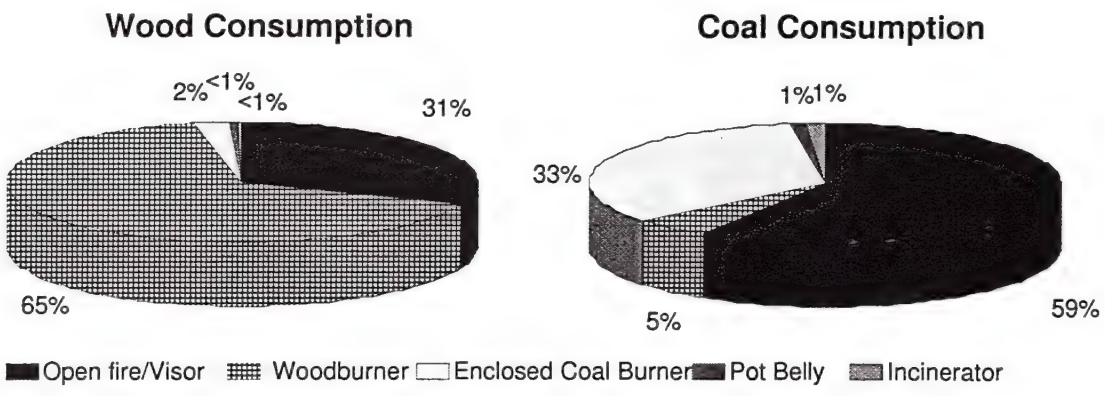


Figure 2.2 Wood and coal consumption across the total study area.

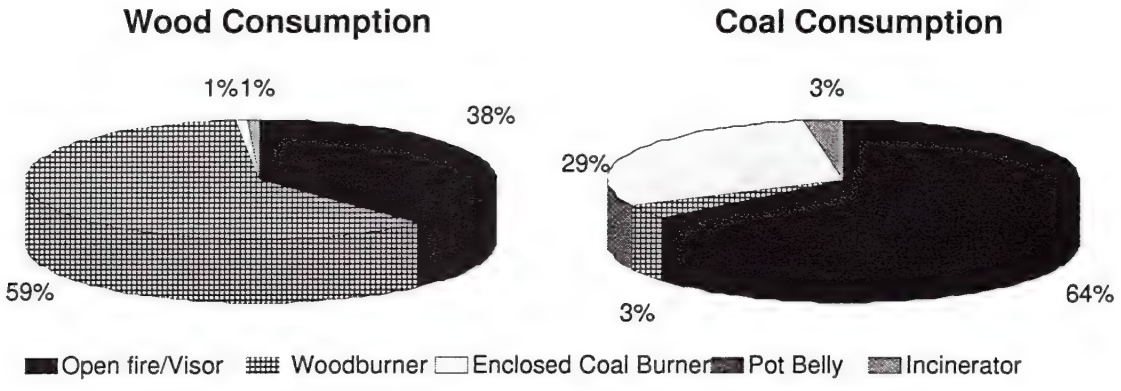


Figure 2.3 Wood and coal consumption across the inner suburb study area.

On an individual suburb basis (Table 2.5 and Table 2.6), fuel and appliance use can vary considerably from suburb to suburb. No households in New Avonhead that have a solid fuel burning appliance burn coal whereas ~40% of households in Spreydon/Addington, Addington Industrial, Racecourse, Marshlands and Beckenham/Sydenham do. Likewise, the appliance that this coal is burnt on can also vary. Coal consumption on open fires/visors and on enclosed coal burners ranges from 0% to 100% across the suburbs, 0% to 25% on woodburners and pot bellies, and 0% to 67% on incinerators.

85% - 100% of households across Christchurch that have and use a solid fuel burning appliance burn wood (Table 2.6). Wood consumption on open fires/visors ranges from 0% of households to 74%, 26% to 100% on woodburners, 0% to 18% on enclosed coal burners and 0% to ~10% on pot bellies and on incinerators.

The only fuel that can be burnt on a Clean Air Approved appliance are those which the appliance has been specifically approved for. In the majority of cases this applies to wood only. Survey results suggest that coal is burnt on appliances approved for the burning of wood only (5% of the daily coal consumption across the total study area and 3% in the inner suburb study area is on woodburners). However, prior to 1988 there were some appliances approved to burn coal.

Table 2.5 Coal use on various appliances (in the main living area) across various study areas of Christchurch.

Suburb Area	Number of Households using Solid Fuel Burning Appliances	Coal Use		Open fire/visor		Woodburner		Enclosed Coal Burner		Pot belly		Incinerator	
		Households		Households		Households		Households		Households		Households	
		Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Inner Suburb Study Area													
Beckenham/Sydenham	1092	455	42	455	100	0	0	0	0	0	0	0	0
Fendalton	2623	1180	39	918	78	131	11	131	11	0	0	0	0
Inner City	1032	380	37	380	100	0	0	0	0	0	0	0	0
Linwood	2676	669	25	335	50	0	0	335	50	0	0	0	0
Opawa/Woolston	1927	350	16	263	75	0	0	88	25	0	0	0	0
Riccarton	1059	397	38	265	67	66	17	66	17	0	0	0	0
Shirley	1931	193	10	0	0	0	0	64	33	0	0	129	67
Spreydon/Addington	3507	1484	41	674	45	135	9	674	45	0	0	0	0
St Albans	5720	1244	22	1244	100	0	0	0	0	0	0	0	0
Sub-total - Inner Suburb Study Area	21568	6352	28	4533	71	332	5	1358	21	0	0	129	2
Outer Suburbs													
Addington Industrial	142	60	41	33	55	0	0	27	45	0	0	0	0
Airport	48	16	33	0	0	0	0	12	75	4	25	0	0
Avonhead	1516	505	33	0	0	0	0	379	75	126	25	0	0
Bishopdale	1588	345	22	345	100	0	0	0	0	0	0	0	0
Bromley	521	93	18	56	60	19	20	19	20	0	0	0	0
Burnside/Bryndwr	3077	769	25	288	38	192	25	288	38	0	0	0	0
Hoon Hay	2012	252	13	252	80	63	20	0	0	0	0	0	0
Hornby	1500	482	32	321	67	0	0	161	33	0	0	0	0
Marshlands	301	125	42	125	100	0	0	0	0	0	0	0	0
New Avonhead	72	0	0	0	0	0	0	0	0	0	0	0	0
New Brighton	6451	1152	18	691	60	230	20	230	20	0	0	0	0
Parklands	553	58	11	0	0	0	0	58	100	0	0	0	0
Racecourse	402	129	32	86	67	0	0	43	33	0	0	0	0
Redwood	1088	453	42	453	100	0	0	0	0	0	0	0	0
Sockburn	1015	326	32	217	67	0	0	109	33	0	0	0	0
Wigram	252	81	32	54	67	0	0	27	33	0	0	0	0
Sub-total	20537	4848	24	2923	60	504	10	1353	28	130	3	0	0
Total - Total Study Area	42105	11200	26	7456	66	836	7	2712	24	130	1	129	1

Table 2.6 Wood use on various appliances (in the main living area) across various study areas of Christchurch.

Suburb Area	Total Number of Solid Fuel Burning Appliances	Wood Use		Open fire/visor		Woodburner		Enclosed Coal Burner		Pot belly		Incinerator	
		Households		Households		Households		Households		Households		Households	
		Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Inner Suburb Study Area													
Beckenham/Sydenham	1092	1001	92	455	45	546	55	0	0	0	0	0	0
Fendalton	2623	2754	91	1574	57	1180	43	0	0	0	0	0	0
Inner City	1032	1032	100	760	74	272	26	0	0	0	0	0	0
Linwood	2676	2676	100	1004	38	1338	50	335	13	0	0	0	0
Opawa/Woolston	1927	1927	88	526	27	1402	73	0	0	0	0	0	0
Riccarton	1059	927	88	397	43	529	57	0	0	0	0	0	0
Shirley	1931	1738	87	193	11	1352	78	0	0	0	0	193	11
Spreydon/Addington	3507	3102	85	1349	43	1619	52	135	4	0	0	0	0
St Albans	5720	5720	100	2238	39	3482	61	0	0	0	0	0	0
Sub-total - Inner Suburb Study Area	21568	20878	93	8496	41	11719	56	469	2	0	0	193	1
Outer Suburbs													
Addington Industrial	142	126	85	60	48	60	48	5	4	0	0	0	0
Airport	48	44	92	4	9	28	64	8	18	4	9	0	0
Avonhead	1516	1389	92	126	9	884	64	253	18	126	9	0	0
Bishopdale	1588	1588	100	622	39	967	61	0	0	0	0	0	0
Bromley	521	521	100	74	14	428	82	19	4	0	0	0	0
Burnside/Bryndwr	3077	2885	94	769	27	1923	67	192	7	0	0	0	0
Hoon Hay	2012	2012	100	314	16	1698	84	0	0	0	0	0	0
Hornby	1500	1447	96	321	22	911	63	161	11	54	4	0	0
Marshlands	301	276	92	125	45	150	55	0	0	0	0	0	0
New Avonhead	72	72	100	0	0	72	100	0	0	0	0	0	0
New Brighton	6451	6451	100	922	14	5299	82	230	4	0	0	0	0
Parklands	553	495	89	29	6	466	94	0	0	0	0	0	0
Racecourse	402	387	96	86	22	244	63	43	11	14	4	0	0
Redwood	1088	997	92	453	45	544	55	0	0	0	0	0	0
Sockburn	1015	978	96	217	22	616	63	109	11	36	4	0	0
Wigram	252	243	96	54	22	153	63	27	11	9	4	0	0
Sub-total	20537	19911	97	4178	21	14443	73	1047	5	243	1	0	0
Total - Total Study Area	42105	40789	95	12674	31	26162	64	1516	4	243	1	193	0

In ten of the 25 suburbs surveyed, householders were also questioned about their wood supply (Table 2.7). On average, 51% of households burn wood obtained from wood merchants. The wood used in the remaining 49% of households was collected from other sources (self-collected etc). Any cost that may have been associated with wood from other sources was not established. Furthermore, a comparison of estimated wood weights from merchants vs other sources concluded that households burn similar quantities of wood regardless of the collection source.

Table 2.7 Source of firewood.

	Merchant (%)	Other Source (%)
Riccarton	24	76
Hornby	56	44
Linwood	60	40
New Brighton	56	44
Burnside/Bryndwr	48	52
Avonhead	50	50
Opawa/Woolston	43	57
Beckenham/Sydenha	80	20
Spreydon/Addington	55	45
Hoon Hay	52	48
Average	51	49

3. Home Heating Emissions

3.1. Home Heating Emission Factors, Calculation Techniques and Assumptions

The home heating emission factors used in this inventory (Table 3.1 and Table 3.2) were developed from a literature survey (United States Environmental Protection Agency (USEPA) (1994), Economopoulos (1993), Brady & Pullen (1985) and Todd (1994)) and through consultation with CRC staff.

The factors in Table 3.1 below outline the differing pollutant emissions for various fuel sources. For example, when comparing the emissions from one kilogram of gas to those from one kilogram of wood, wood produces 100 times the quantity of PM_{10} and VOC, 200 times the amount of CO, 20 times the amount of SO_x, just over half the amount of NO_x (55%) and about two thirds the amount of CO_2 (68%).

Compared to the burning one kilogram of wood, the burning of one kilogram of coal produces over two times the emissions of PM_{10}, nearly twice the emissions of CO_2, is responsible for almost all of the SO_x emissions (90%) and emits only half the VOCs and CO. Yet to produce the same degree of heat from a given quantity of wood only about half the amount of coal is required (e.g. wood releases approximately 10 MJ/kg whereas sub-bitumnal coal releases approximately 20 MJ/kg).

Table 3.1 The fuel factors used to calculate home heating emissions.

Fuel Factor	PM_{10}	CO	NO_x	SO_x	VOC	CO_2
gas (g/kg)	0.1	0.4	2.0	0.01	0.2	2500
oil (g/l)	1.3	0.6	2.2	3.8	0.25	3200
wood (g/kg)	10.0	80.0	1.1	0.2	20.0	1700
coal (g/kg)	22.0	40.0	1.0	18.0	10.0	2800

Table 3.1 however, does not take into account the age and type of appliance on which various solid fuels are being burnt. To compensate for differing appliances (i.e. a typical coal-burning appliance, which is more polluting, compared to a typical woodburner) and incorrect operation, the emissions produced by various fuels need to be multiplied by an 'appliance factor' (Table 3.2).

Table 3.2 The appliance factors used to calculate home heating emissions.

Appliance Factor	PM_{10}	CO	NO_x	SO_x	VOC	CO_2
open fire	1.50	1.50	1.50	1.00	1.50	1.00
woodburner pre 89	1.28	1.28	1.28	1.00	1.28	1.00
woodburner 90-92 (incl)	0.69	0.69	0.69	1.00	0.69	1.00
woodburner 93+	0.59	0.59	0.59	1.00	0.59	1.00
enclosed coal burner	1.43	1.43	1.43	1.00	1.43	1.00
pot belly	1.43	1.43	1.43	1.00	1.43	1.00
incinerator	1.56	1.56	1.56	1.00	1.56	1.00

Generally, typical open fires, incinerators, pot bellies and enclosed coal burners produce approximately 1.2 times the emissions of PM_{10}, CO, NO_x and VOCs of pre 1989 woodburners for a given fuel. This value is even greater when compared to later model woodburners (approximately 2.5 times compared to a post-1993 woodburner).

With the exception of CO_2, the emissions from the burning of gas and oil are relatively minor and are not subject to 'appliance' factors.

The following assumptions have been made:

1. typical coal is 1.0 wt% sulphur
2. daily winter fuel consumption in solid fuel appliances e.g. woodburners etc. = a typical winter's night fuel consumption
3. daily winter fuel consumption for natural gas and fuel oil = total weekly fuel consumption / 7 days
4. a "log" of wood = 1.6kg
5. a "bucket" of coal = 10kg

Overall, home heating emissions were calculated for a typical winter's day and aggregated to a total using the following formula:

$$\textit{Home Heating Emissions (g)} = \textit{Fuel Factor} * \textit{Appliance Factor} * \textit{Daily Fuel Use}$$

So, to determine the total PM_{10} emissions from the burning of 20kg of wood on an open fire the equation would look like:

$$PM_{10}\textit{ Emissions (g)} = 10.0\ g/kg * 1.5 * 20\ kg.$$

The aggregated total home heating emissions for each pollutant were then divided by the number of hectares within each suburb (1 hectare = $10000m^2$). This gave a "normalised" weight per area value (e.g. grams per hectare) and allowed fair comparison of home heating emissions with emissions from other sources.

The Canterbury Regional Council supplied a woodburner age breakdown for each suburb area. These statistics, which are based on building consent records from the Christchurch City Council, indicate that the majority of woodburner installations are in existing dwellings but give no detail as to what the woodburner installations replace.

3.2. Home Heating Emissions on a Typical Winter's Day by Fuel Use and Appliance Type

The main contaminant emissions from the burning of solid fuels on different types of appliances (as applicable) within the total study area and from the inner suburb study area are outlined in Table 3.4 and Table 3.5.

As previously mentioned, the contaminant of main concern in Christchurch is fine particulates (PM_{10}). Across the total study area of Christchurch, the burning of wood and coal on open fires is estimated to produce 48% of the home heating PM_{10} emissions (25% from wood, 23% from coal) while the burning of wood on woodburners produces 34% (Table 3.3 and Figure 3.1). Of the latter, PM_{10} emissions from pre 1989 woodburners are twice those of the later models combined. 15% of PM_{10} emissions stem from the burning of wood and coal on enclosed coal burners (2% from wood, 13% from coal). The remaining emissions from the burning of coal (3%) are divided evenly between incinerators, pre 1989 woodburners and post 1993 woodburners.

Within the inner suburb study area, the burning of wood and coal on open fires/visors contributes to approximately 56% of PM_{10} emissions while wood and coal burning on woodburners and enclosed coal burners contribute slightly less (31% and 12% respectively). The burning of wood and coal on incinerators produces around 2% of PM_{10} emissions (Table 3.3 and Figure 3.1).

Table 3.3 Percentage of PM_{10} emissions from the burning of wood and coal on various appliances within the total study area and the inner suburb study area.

Fuel and Appliance	Total Study Area	Inner Suburb Study Area
Open fire		
- Wood	25	30
- Coal	23	26
Pre 1989 Woodburner		
- Wood	23	20
- Coal	1	1
1989-1992 (incl) Woodburner		
- Wood	6	5
- Coal	0	0
Post 1993 Woodburner		
- Wood	5	5
- Coal	1	0
Enclosed Coal Burner		
- Wood	2	1
- Coal	13	11
Pot Belly		
- Wood	0	0
- Coal	0	0
Incinerator		
- Wood	0	1
- Coal	1	1

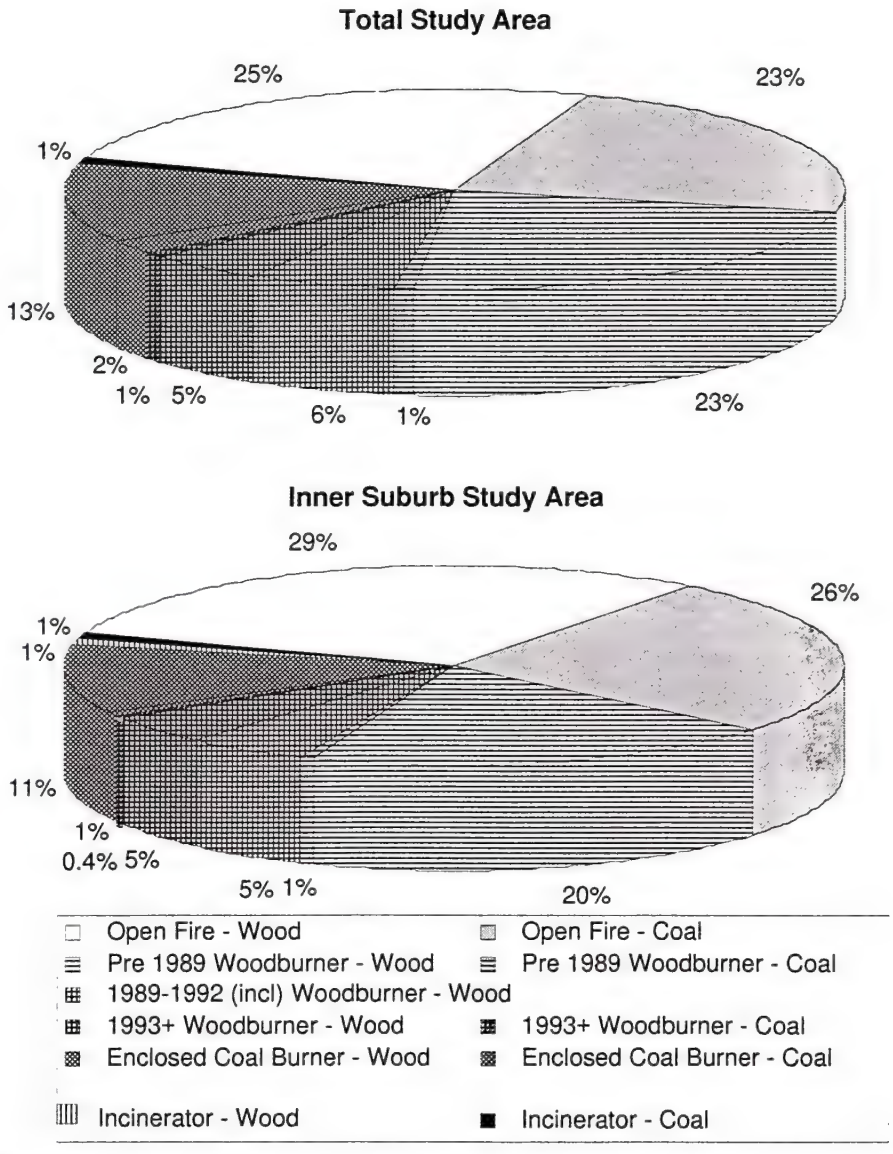


Figure 3.1 Percentage of PM_{10} emissions from the burning of wood and coal on various appliances within the total study area and the inner suburb study area.

Table 3.4 Estimated pollutant emissions from various fuels and appliances across the total study area.

	Daily Fuel Quantity			PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg/day	t/day	Use (%)	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Open fire																					
- Wood	184754	184.8	31	2771	156	25	22171	1249	36	305	17	33	37	2	1	5543	312	36	314083	17688	23
- Coal	77112	77.1	59	2545	143	23	4627	261	7	116	7	12	1388	78	56	1157	65	7	215913	12159	16
Pre 1989 Woodburner																					
- Wood	198421	198.4	33	2540	143	23	20318	1144	33	279	16	30	40	2	2	5080	286	33	337316	18996	25
- Coal	2935	2.9	2	83	5	1	150	8	0	4	0	0	53	3	2	38	2	0	8217	463	1
1989-1992 (incl) Woodburner																					
- Wood	88400	88.4	15	610	34	6	4880	275	8	67	4	7	18	1	1	1220	69	8	150279	8463	11
- Coal	186	0.2	0	3	0	0	5	0	0	0	0	0	3	0	0	1	0	0	521	29	0
Post 1993 Woodburner																					
- Wood	101708	101.7	17	600	34	5	4801	270	8	66	4	7	20	1	1	1200	68	8	172904	9737	13
- Coal	4427	4.4	3	57	3	1	104	6	0	3	0	0	80	4	3	26	1	0	12396	698	1
Enclosed Coal Burner																					
- Wood	14113	14.1	2	202	11	2	1615	91	3	22	1	2	3	0	0	404	23	3	23993	1351	2
- Coal	43866	43.9	33	1380	78	13	2509	141	4	63	4	7	790	44	32	627	35	4	122826	6917	9
Pot Belly																					
- Wood	2495	2.5	0	36	2	0	285	16	0	4	0	0	0	0	0	71	4	0	4242	239	0
- Coal	1303	1.3	1	41	2	0	75	4	0	2	0	0	23	1	1	19	1	0	3647	205	0
Incinerator																					
- Wood	2418	2.4	0	38	2	0	302	17	0	4	0	0	0	0	0	75	4	0	4110	231	0
- Coal	1931	1.9	1	66	4	1	120	7	0	3	0	0	35	2	1	30	2	0	5407	304	0
Total Wood	592310	592.3	82	6796	383	62	54371	3062	88	748	42	80	118	7	5	13593	765	88	1006926	56706	73
Total Coal	131760	131.8	18	4175	235	38	7591	427	12	190	11	20	2372	134	95	1898	107	12	368927	20776	27
Total Gas	45461	45.5		5	0		18	1		91	5		0	0		9	1		113653	6400	
Total Oil	12343	12.3		16	1		7	0		27	2		47	3		3	0		39497	2224	
Total (Wood and Coal)	724069	724		10971	618	100	61962	3489	100	937	53	100	2490	140	100	15490	872	100	1375853	77482	100

Table 3.5 Estimated pollutant emissions from various fuels and appliances across the inner suburb study area.

	Daily Fuel Quantity			PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg/day	t/day	Use (%)	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Open fire																					
- Wood	110619	110.6	38	1659	276	30	13274	2206	43	183	30	39	22	4	2	3319	552	43	188052	31258	28
- Coal	43832	43.8	64	1446	240	26	2630	437	8	66	11	14	789	131	61	657	109	8	122730	20400	18
Pre 1989 Woodburner																					
- Wood	86387	86.4	30	1106	184	20	8846	1470	28	122	20	26	17	3	1	2212	368	28	146858	24411	22
- Coal	1012	1.0	1	28	5	1	52	9	0	1	0	0	18	3	1	13	2	0	2832	471	0
1989-1992 (incl) Woodburner																					
- Wood	38734	38.7	13	267	44	5	2138	355	7	29	5	6	8	1	1	535	89	7	65848	10945	10
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post 1993 Woodburner																					
- Wood	46886	46.9	16	277	46	5	2213	368	7	30	5	6	9	2	1	553	92	7	79707	13249	12
- Coal	1642	1.6	2	21	4	0	39	6	0	1	0	0	30	5	2	10	2	0	4599	764	1
Enclosed Coal Burner																					
- Wood	2752	2.8	1	39	7	1	315	52	1	4	1	1	1	0	0	79	13	1	4678	778	1
- Coal	20232	20.2	29	636	106	11	1157	192	4	29	5	6	364	61	28	289	48	4	56649	9416	8
Pot Belly																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incinerator																					
- Wood	2418	2.4	1	38	6	1	302	50	1	4	1	1	0	0	0	75	13	1	4110	683	1
- Coal	1931	1.9	3	66	11	1	120	20	0	3	1	1	35	6	3	30	5	0	5407	899	1
Total Wood	287796	287.8	81	3386	563	61	27088	4503	87	372	62	79	58	10	4	6772	1126	87	489253	81324	72
Total Coal	68649	68.6	19	2199	366	39	3998	665	13	100	17	21	1236	205	96	1000	166	13	192217	31950	28
Total Gas	21226	21.2		2	0		8	1		42	7		0	0		4	1		53065	8821	
Total Oil	10058	10.1		13	2		6	1		22	4		38	6		3	0		32184	5350	
Total (Wood and Coal)	356445	356		5585	928	100	31086	5167	100	472	79	100	1293	215	100	7772	1292	100	681470	113274	100

For the other contaminants, the relative contribution of open fires, woodburners and other appliances to pollutant emissions in the total study area and the inner suburb study area are shown in Table 3.4 and Table 3.5, and also summarised in Table 3.6. Like PM_{10}, most of the CO, NO_X, SO_X, VOC and CO_2 emissions are produced from the burning of wood and coal (primarily wood) on open fires and woodburners.

Table 3.6 Relative contribution of open fires, woodburners and other burning appliances to pollutant emissions within the total study area and the inner suburb study area.

	Open Fires %		Woodburners %		Other Burning Appliances %	
	Total Area	Inner Suburb Area	Total Area	Inner Suburb Area	Total Area	Inner Suburb Area
PM_{10}	48	56	35	30	16	14
CO	43	51	49	43	8	6
NO_x	45	53	45	39	10	9
SO_x	57	63	9	6	34	31
VOC	43	51	49	43	8	6
CO_2	39	46	50	44	12	10

Across the total study area, open fires are responsible for approximately 43% of CO emissions, 45% of NO_x emissions, 57% of SO_x emissions, 43% of VOC emissions and 39% of CO_2 emissions (Table 3.6). Of those emissions, wood burning on an open fire produces 36% of CO emissions, 33% of NO_x emissions, 1% of SO_x emissions, 36% of VOC emissions and 23% of CO_2 emissions. Coal burning on an open fire makes up the difference (Table 3.4).

The burning of wood on woodburners across the total study area produces approximately 49% of CO emissions, 45% of NO_x emissions, 4% of SO_x emissions, 49% of VOC emissions and 49% of CO_2 emissions (Table 3.6). Coal burning on woodburners contributes to a small percentage of CO_2 emissions (2%) and to over half of the SO_x emissions (5%) (Table 3.4).

Within the inner suburb study area, the burning of wood and coal on open fires produces 51% of CO emissions, 53% of NO_x emissions, 63% of SO_x emissions, 51% of VOC emissions and 46% of CO_2 emissions (Table 3.6). Of those emissions, wood burning on an open fire produces 43% of CO emissions, 39% of NO_x emissions, 2% of SO_x emissions, 43% of VOC emissions and 28% of CO_2 emissions. Coal burning on open fires makes up the difference (61% in the case of SO_x) (Table 3.5).

The burning of wood and coal on woodburners produces approximately 43% of CO emissions, 39% of NO_x emissions, 6% of SO_x emissions, 43% of VOC emissions and 44% of CO_2 emissions. (Table 3.6). Coal burning on woodburners contributes to a small percentage of CO_2 emissions (1%) and to half of the SO_x emissions (3%) (Table 3.5).

Across the total study area, 32% of SO_x, 7% of NO_x and 9% of CO_2 comes from the burning of coal on enclosed coal burners (Table 3.4). Within the inner suburb study area, 28% of SO_x, 6% of NO_x and 8% of CO_2 comes from coal burning on these appliances (Table 3.5).

Individual suburb results can be found in Appendix III

3.3. Comparison of Average PM_{10}, CO and SO_x Emissions Per Household with Methods of Home Heating on a Household Basis

Table 3.8 displays PM_{10}, CO and SO_X emissions per household in descending order of PM_{10} for each suburb.

Statistical analysis of Table 3.8 indicates that pollutant emissions are dependent on the methods of home heating in the main living area on a typical winter's day (Table 3.7). At the 95% confidence level, PM_{10} emissions are positively correlated with the use of open fires (0.54) and enclosed coal burners (0.50). The relationship between PM_{10} and woodburner use is significant at the 99% confidence level (0.64). PM_{10} emissions per household are not statistically related to the use of gas, oil burners, pot bellies and incinerators, and are negatively correlated to electricity use (-0.59).

Table 3.7 Pearson analysis of pollutant emissions and appliance use

	Electricity	Gas (LPG)	Oil fire	Open fire/Visor	Woodburner	Enclosed Coal Burner	Pot Belly	Incinerator
PM_{10}	-0.59	0.37	0.27	0.54	0.64	0.50	0.22	-0.14
CO	-0.67	0.21	-0.01	0.46	0.82	0.09	-0.03	0.00
SO_x	-0.32	0.41	0.52	0.45	0.24	0.83	0.43	-0.26

CO emissions are positively correlated to the use of open fires (0.46) and woodburners (0.82) at the 99% confidence level. Again, the use of electricity is negatively correlated with CO levels (-0.67). CO is released when gas, oil fires, enclosed coal burners, pot bellies and incinerators are used. Statistical analysis of the results indicates that the relationship between CO is not significant with gas (0.21), oil fires (-0.01), enclosed coal burners (0.09), pot bellies (-0.03) and incinerators (0.00).

SO_x emissions are positively correlated with the use of open fires, oil fires, pot bellies and gas at the 95% confidence level (0.45, 0.52, 0.43, and 0.41 respectively) and are correlated with the use enclosed coal burners at the 99% confidence level (0.83). SO_x is released when woodburners and incinerators are used but statistically the relationship is not significant (woodburners (0.24) and incinerators (-0.26)). SO_x emissions are not statistically related to electricity (-0.32).

As would be expected the suburbs with the highest PM_{10} emissions on a per household basis are those with the greatest percentage of solid fuel burning methods of home heating. Burnside/Bryndwr, for example, recorded the highest PM_{10} emissions per household whereas New Avonhead recorded the lowest PM_{10}, CO and SO_x emissions. 40% of the households in Burnside/Bryndwr use a woodburner to heat the main living area on a typical winter's day whereas woodburners are used in 9% of New Avonhead households. In addition to this, 18% of households in Burnside/Bryndwr use an open fire. In contrast, there are not open fires in use in New Avonhead. Furthermore, 95% of the households use electricity. Only 64% of households used electricity in Burnside/Bryndwr.

A similar pattern emerges when looking at the suburbs that display high CO and SO_x emissions per household. Hoon Hay recorded the highest CO emissions per household. 54% of the households use a woodburner and 10% use open fires to heat the main living area on a typical winter's day. Furthermore, 46% of the households use electricity.

Spreydon/Addington and Addington Industrial recorded the highest SO_x emissions per household. In these suburbs 22% and 24% of households respectively use woodburners, 20% and 22% use open fires, 10% of households in each suburb use enclosed coal burners. Electricity was used in 58% of households.

With the exception of New Avonhead, no apparent variation in emissions or home heating methods is evident relative to the age of the dwellings in an area. An additional study would be required to establish whether there are any relationships between the socio-economic structure of households, heating methods and emissions.

Table 3.8 Average emissions per household from home heating in descending order of PM_{10} for the individual suburb areas of Christchurch - Typical winter's day.

Suburb Area	Total No of Households	Housing Density (houses/ha)	Individual Households grams PM_{10}	CO	SOx	% of Households Using Electricity	Gas (LPG)	Oil fire	Open fire/Visor	Enclosed Woodburner	Coal Burner	Pot Belly	Incinerator
Burnside/Bryndwr	4808	10.5	174	957	43	64	14	4	18	40	6	0	0
Hornby	2679	5.4	166	775	51	62	30	8	12	34	8	2	0
Sockburn	1812	6.9	165	773	51	62	30	8	12	34	8	2	0
Racecourse	717	2.9	162	743	51	62	30	8	12	34	8	2	0
Wigram	450	0.6	161	741	51	62	30	8	12	34	8	2	0
Spreydon/Addington	6744	9.1	159	634	59	58	22	8	20	24	10	0	0
Addington Industrial	273	1.2	155	599	59	58	22	8	22	22	10	0	0
Hoon Hay	3144	7.5	150	1018	18	46	24	2	10	54	0	0	0
Fendalton	6033	8.1	149	748	43	83	7	2	28	20	2	0	0
Bromley	930	1.2	142	886	26	58	18	8	8	46	2	0	0
New Brighton	11520	5.9	139	870	26	58	18	8	8	46	2	0	0
St Albans	9948	11.5	125	823	17	63	10	0	23	35	0	0	0
Inner City	2715	4.3	118	650	27	80	24	0	28	10	0	0	0
Bishopdale	3453	3.9	102	675	14	50	8	0	18	28	0	0	0
Opawa/Woolston	4380	5.5	99	658	14	70	22	4	12	32	2	0	4
Shirley	4377	7.6	89	589	12	81	6	0	6	31	1	0	7
Redwood	4533	6.0	82	479	16	72	26	4	12	12	0	0	0
Beckenham/Sydenham	4551	8.2	82	479	16	72	26	4	12	12	0	0	0
Marshlands	1254	1.1	82	479	16	72	26	4	12	12	0	0	0
Riccarton	3309	9.5	74	366	22	82	4	4	14	16	2	0	0
Linwood	8364	11.1	72	419	15	70	18	6	12	16	4	0	0
Avonhead	6315	8.7	67	302	22	86	14	12	2	14	6	2	0
Airport	198	0.1	65	288	22	86	14	12	2	14	6	2	0
Parklands	1572	5.0	59	363	11	54	15	0	2	30	4	0	0
New Avonhead	777	3.4	13	104	0	93	16	0	0	9	0	0	0
Average	3794	5.8	114	617	28	68	19	5	13	26	4	0	0
Median	3309	5.9	118	650	22	64	18	4	12	28	2	0	0

3.4. Home Heating Emissions on a Typical Winter's Day on a Suburb and Area Basis

Home heating emissions to the air on a typical winter's day for various study areas of Christchurch are presented in Table 3.9 over.

In addition to emissions per household, other factors contribute to variations in the volume and concentration of home heating emissions on a suburb-by-suburb basis. These factors include variations in suburb size, the number of dwellings and the density of housing. For example, the areas included in Addington Industrial, Bromley and Wigram are among the areas with the higher emissions on a per household basis (Table 3.8) but fall within the areas with low emissions on a suburb basis. The above example reflects how low housing density within a study area can influence area based results (i.e. g/ha/day) even though housing, and associated emissions, may be concentrated in particular locations within the suburb.

The total study area is estimated to produce approximately 10971 kilograms of PM_{10} per day or 618 gram per hectare per day whereas the inner suburb study area is estimated to produce 51% of the total PM_{10} emissions (5585 kg/day) (Table 3.9). On a grams per hectare basis, the PM_{10} emissions from home heating within the inner suburb study area are 1.5 times greater than the total study area (928 g/ha/day compared to 618 g/ha/day).

A similar pattern emerges when examining the CO, NO_x, SO_x, VOC and CO_2 emissions from home heating (Table 3.9). The inner suburb study area is estimated to produce 50% of the total CO, NO_x, VOC and CO_2 emissions, and 52% of the total SO_x. On a grams per hectare basis, the inner suburb study area produces 1.5 times more CO, NO_x, SO_x, VOC and CO_2 than the total study area.

On an individual suburb basis (Table 3.9), home heating emissions vary considerably from suburb to suburb. For example, when comparing New Avonhead (the suburb with the lowest total and grams per hectare pollutant emissions) with Burnside/Bryndwr (the suburb with the highest grams per hectare pollutant emissions), PM_{10} emissions per hectare in Burnside/Bryndwr can be as much as 41 times larger than those in New Avonhead. CO and NO_x can be as much as 30 times larger, VOC 28 times larger, CO_2 20 times larger and SO_x 450 times greater.

Table 3.9 Typical winter's day emissions from home heating for various suburb areas of Christchurch.

		PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
Suburb Area	Area (ha)	kg	% Total	g/ha	kg	% Total	g/ha	kg	% Total	g/ha	kg	% Total	g/ha	kg	% Total	g/ha	kg	% Total	g/ha
Inner Suburb Study Area																			
Beckenham/Sydenham	555	371	3	669	2178	4	3927	33	3	59	73	3	132	545	4	982	43019	3	77554
Fendalton	745	900	8	1208	4513	7	6057	71	8	95	259	10	348	1128	7	1514	103340	8	138711
Inner City	635	321	3	506	1764	3	2780	27	3	42	74	3	117	441	3	695	35211	3	55486
Linwood	754	604	6	801	3507	6	4651	53	6	70	127	5	168	877	6	1163	73506	5	97501
Opawa/Woolston	798	435	4	545	2881	5	3609	42	4	52	60	2	75	720	5	902	61045	4	76469
Riccarton	349	246	2	705	1211	2	3468	19	2	55	73	3	211	303	2	867	28248	2	80941
Shirley	572	389	4	680	2577	4	4504	37	4	65	52	2	91	644	4	1126	54586	4	95380
Spreydon/Addington	745	1074	10	1442	4273	7	5739	73	8	98	401	16	539	1068	7	1435	116677	8	156697
St Albans	864	1245	11	1441	8182	13	9474	118	13	137	173	7	201	2046	13	2368	165838	12	192009
Sub-total - Inner Suburb Study Area	6016	5585	51	928	31086	50	5167	472	50	79	1293	52	215	7772	50	1292	681470	50	113274
Outer Suburbs																			
Addington Industrial	230	42	0	185	163	0	712	3	0	12	16	1	71	41	0	178	4730	0	20609
Airport	2088	13	0	6	57	0	27	1	0	0	4	0	2	14	0	7	1524	0	730
Avonhead	727	423	4	582	1907	3	2625	31	3	43	140	6	192	477	3	656	48598	4	66884
Bishopdale	887	353	3	398	2331	4	2629	34	4	38	48	2	54	583	4	657	46051	3	51947
Bromley	764	132	1	173	824	1	1078	12	1	16	24	1	32	206	1	269	18250	1	23888
Burnside/Bryndwr	460	838	8	1824	4603	7	10018	70	7	153	208	8	452	1151	7	2504	103195	8	224582
Hoon Hay	421	472	4	1121	3202	5	7598	46	5	109	58	2	137	800	5	1900	67028	5	159060
Hornby	498	444	4	891	2077	3	4169	33	4	67	136	5	272	519	3	1042	51094	4	102579
Marshlands	1135	102	1	90	600	1	529	9	1	8	20	1	18	150	1	132	11854	1	10441
New Avonhead	230	10	0	44	81	0	351	1	0	5	0	0	1	20	0	88	1789	0	7778
New Brighton	1942	1607	15	828	10023	16	5162	147	16	76	301	12	155	2506	16	1291	226068	16	116434
Parklands	312	93	1	297	571	1	1828	8	1	27	17	1	55	143	1	457	14536	1	46561
Racecourse	247	116	1	468	533	1	2154	9	1	35	36	1	147	133	1	539	13675	1	55274
Redwood	752	369	3	492	2170	4	2887	32	3	43	73	3	97	542	4	722	42849	3	57018
Sockburn	264	300	3	1134	1400	2	5301	23	2	85	92	4	347	350	2	1325	34559	3	130806
Wigram	786	73	1	92	333	1	424	5	1	7	23	1	29	83	1	106	8582	1	10925
Sub-total	11741	5386	49	459	30875	50	2630	465	50	40	1197	48	102	7719	50	657	694383	50	59142
Total - Total Study Area	17757	10971	100	618	61962	100	3489	937	100	53	2490	100	140	15490	100	872	137585	100	77482

3.5. Home Heating Emissions by Time of Day

Across the total study area, ~78% of PM_{10}, CO, NO_x, SO_x, VOC and CO_2 are emitted between 4pm and 6am on a typical winter's night (Table 3.10 and Figure 3.2). The next highest period of emissions occurs between 10am and 4pm across all pollutants (15% of each pollutant released during this time).

Within the inner suburb study area, ~80% of pollutants are emitted between 4pm and 6am on a typical winter's night (Table 3.11 and Figure 3.3). Like the total study area, the next highest period of emissions occurs from 10am to 4pm across all pollutants (with 12%-14% released during this time).

In the total study area and the inner suburb study area, estimated PM_{10}, CO, NO_x, SO_x, VOC and CO_2 emissions are lowest between the hours of 6am and 10am when ~7% of the total daily emissions are released.

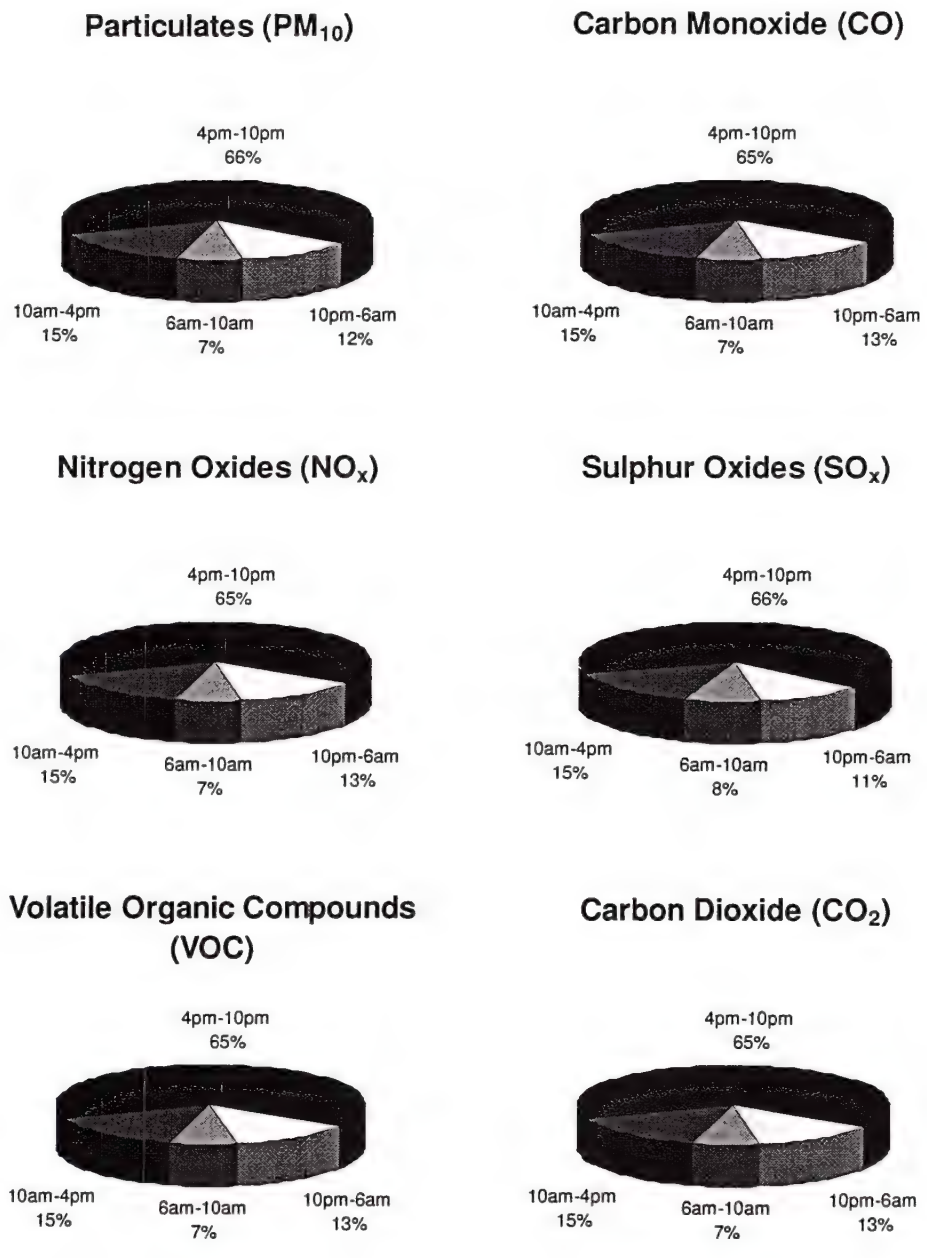


Figure 3.2 Time distribution of home heating emissions across the total study area.

Table 3.10 Estimated home heating emissions for various times of a typical winter's day across the total study area.

	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
6am-10am	788	44	7	4388	247	7	67	4	7	187	11	8	1097	62	7	103073	5805	7
10am-4pm	1623	91	15	9096	512	15	138	8	15	377	21	15	2274	128	15	205651	11581	15
4pm-10pm	7201	406	66	40485	2280	65	613	35	65	1640	92	66	10121	570	65	887048	49955	64
10pm-6am	1360	77	12	7992	450	13	119	7	13	286	16	11	1998	113	13	180081	10141	13
Total	10971	618	100	61962	3489	100	937	53	100	2490	140	100	15490	872	100	1375853	77482	100

Table 3.11 Estimated home heating emissions for various times of a typical winter's day across the inner suburb study area of Christchurch.

	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
6am-10am	384	64	7	2117	352	7	32	5	7	93	15	7	529	88	7	49614	8247	7
10am-4pm	751	125	13	4378	728	14	66	11	14	161	27	12	1094	182	14	95681	15904	14
4pm-10pm	3922	652	70	21414	3559	69	327	54	69	932	155	72	5353	890	69	463559	77053	68
10pm-6am	528	88	9	3177	528	10	47	8	10	107	18	8	794	132	10	72616	12070	11
Total	5585	928	100	31086	5167	100	472	79	100	1293	215	100	7772	1292	100	681470	113274	100

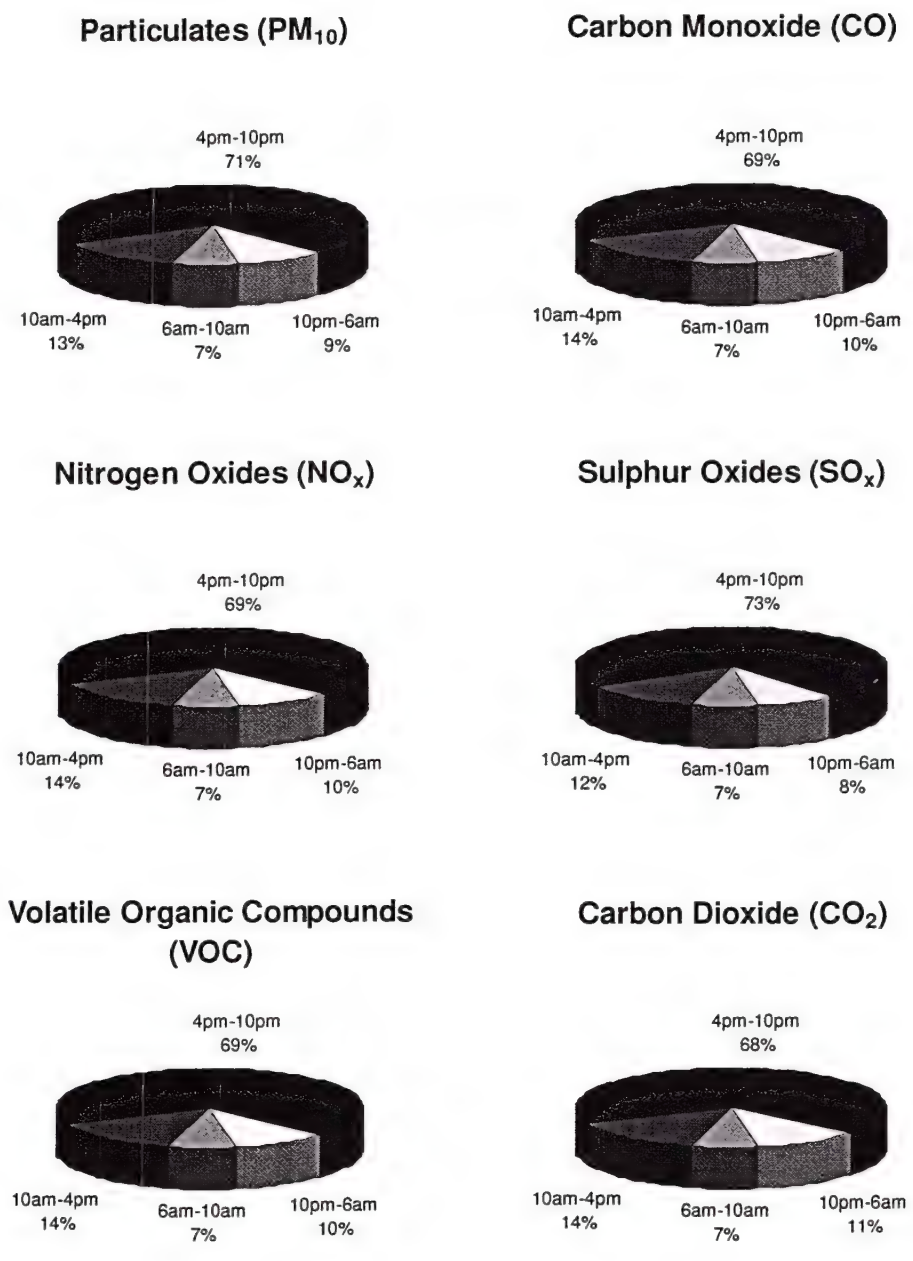


Figure 3.3 Time distribution of home heating emissions across the inner suburb area of Christchurch.

On an individual suburb basis, PM_{10}, CO, VOC, SO_x, NO_x and CO_2 emissions peaked between 4pm and 10pm (Table 3.12 through to Table 3.17). In approximately 65% of the suburbs, the next highest period of emissions occurs between 10am and 4pm. In the suburbs where the secondary peak did not occur between 10am and 4pm it tended to be highest between 10pm and 6am. For SO_x and NO_x, 60% and 68% of the suburbs respectively displayed a low period between 6am and 10am. For PM_{10}, the low period occurred between 6am and 10am for 72% of the suburbs while in over 80% of the suburbs the CO_2, CO and VOC emissions recorded the lowest emissions between 6am and 10am.

Table 3.12 PM_{10} emissions produced at different times of a typical winter's day from home heating across various suburb areas of Christchurch.

Suburb Area	Area (ha)	6am-10am			10am-4pm			4pm-10pm			10pm-6am			Daily Total		
		kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total
Inner Suburb Study Area																
Beckenham/Sydenham	555	28	50	7	96	173	26	230	414	62	18	32	5	371	669	100
Fendalton	745	69	93	8	78	105	9	702	943	78	50	67	6	900	1208	100
Inner City	635	4	6	1	41	64	13	266	420	83	10	16	3	321	506	100
Linwood	754	17	22	3	94	125	16	434	575	72	59	79	10	604	801	100
Opawa/Woolston	798	24	30	6	49	62	11	294	368	67	68	85	16	435	545	100
Riccarton	349	15	43	6	32	92	13	185	530	75	14	40	6	246	705	100
Shirley	572	37	65	10	56	97	14	228	398	59	69	120	18	389	680	100
Spreydon/Addington	745	76	102	7	133	178	12	713	958	66	152	204	14	1074	1442	100
St Albans	864	115	133	9	172	200	14	870	1007	70	88	101	7	1245	1441	100
Sub-total - Inner Suburb Study Area	6016	384	64	7	751	125	13	3922	652	70	528	88	9	5585	928	100
Outer Suburbs																
Addington Industrial	230	3	13	7	5	22	12	28	123	67	6	26	14	42	185	100
Airport	2088	1	1	9	3	2	25	7	3	55	1	1	10	13	6	100
Avonhead	727	39	54	9	104	143	25	237	326	56	43	59	10	423	582	100
Bishopdale	887	32	36	9	48	54	14	245	277	69	28	31	8	353	398	100
Bromley	764	11	14	8	10	13	8	85	111	65	26	34	20	132	173	100
Burnside/Bryndwr	460	48	104	6	119	259	14	516	1122	62	156	339	19	838	1824	100
Hoon Hay	421	36	84	8	92	219	20	263	624	56	82	194	17	472	1121	100
Hornby	498	25	49	6	106	214	24	247	496	56	66	132	15	444	891	100
Marshlands	1135	8	7	7	26	23	26	63	56	62	5	4	5	102	90	100
New Avonhead	230	0	1	3	0	2	4	9	39	88	1	2	5	10	44	100
New Brighton	1942	133	68	8	124	64	8	1026	528	64	325	167	20	1607	828	100
Parklands	312	15	46	16	20	65	22	53	170	57	5	15	5	93	297	100
Racecourse	247	6	25	5	28	113	24	64	260	56	17	69	15	116	468	100
Redwood	752	27	36	7	96	127	26	229	304	62	18	24	5	369	492	100
Sockburn	264	16	62	6	72	272	24	167	631	56	44	168	15	300	1134	100
Wigram	786	4	5	5	18	22	24	40	51	56	11	14	15	73	92	100
Sub-total	11741	403	34	7	872	74	16	3279	279	61	832	71	15	5386	459	100
Total - Total Study Area	17757	788	44	7	1623	91	15	7201	406	66	1360	77	12	10971	618	100

Table 3.13 CO emissions produced at different times of a typical winter's day from home heating across various suburb areas of Christchurch.

Suburb Area	Area (ha)	6am-10am			10am-4pm			4pm-10pm			10pm-6am			Daily Total		
		kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total
Inner Suburb Study Area																
Beckenham/Sydenham	555	162	292	7	680	1226	31	1193	2151	55	143	258	7	2178	3927	100
Fendalton	745	298	399	7	399	536	9	3453	4635	77	363	487	8	4513	6057	100
Inner City	635	30	47	2	274	432	16	1377	2170	78	83	131	5	1764	2780	100
Linwood	754	134	178	4	497	659	14	2401	3185	68	474	629	14	3507	4651	100
Opawa/Woolston	798	192	240	7	360	451	12	1832	2294	64	498	623	17	2881	3609	100
Riccarton	349	42	121	3	129	369	11	1014	2905	84	25	72	2	1211	3468	100
Shirley	572	230	401	9	345	602	13	1585	2770	62	418	730	16	2577	4504	100
Spreydon/Addington	745	236	317	6	504	677	12	3060	4109	72	473	635	11	4273	5739	100
St Albans	864	793	918	10	1189	1377	15	5499	6367	67	701	812	9	8182	9474	100
Sub-total - Inner Suburb Study Area	6016	2117	352	7	4378	728	14	21414	3559	69	3177	528	10	31086	5167	100
Outer Suburbs																
Addington Industrial	230	9	40	6	18	79	11	118	514	72	18	79	11	163	712	100
Airport	2088	5	3	9	11	5	20	35	17	61	6	3	10	57	27	100
Avonhead	727	170	234	9	371	510	19	1187	1634	62	180	247	9	1907	2625	100
Bishopdale	887	220	248	9	330	373	14	1557	1756	67	223	252	10	2331	2629	100
Bromley	764	60	78	7	57	74	7	549	719	67	158	206	19	824	1078	100
Burnside/Bryndwr	460	230	501	5	689	1499	15	2926	6367	64	759	1651	16	4603	10018	100
Hoon Hay	421	236	560	7	602	1429	19	1784	4234	56	579	1374	18	3202	7598	100
Hornby	498	150	302	7	459	921	22	1129	2268	54	338	679	16	2077	4169	100
Marshlands	1135	45	39	7	187	165	31	329	290	55	39	35	7	600	529	100
New Avonhead	230	2	9	3	3	13	4	72	311	88	4	18	5	81	351	100
New Brighton	1942	746	384	7	712	367	7	6604	3401	66	1962	1010	20	10023	5162	100
Parklands	312	74	236	13	99	316	17	362	1160	63	36	116	6	571	1828	100
Racecourse	247	38	153	7	119	482	22	289	1168	54	87	351	16	533	2154	100
Redwood	752	162	215	7	677	902	31	1188	1581	55	142	190	7	2170	2887	100
Sockburn	264	101	381	7	309	1168	22	762	2886	54	229	866	16	1400	5301	100
Wigram	786	24	30	7	75	95	22	180	230	54	54	69	16	333	424	100
Sub-total	11741	2271	193	7	4718	402	15	19072	1624	62	4815	410	16	30875	2630	100
Total - Total Study Area	17757	4388	247	7	9096	512	15	40485	2280	65	7992	450	13	61962	3489	100

Table 3.14 NO_x emissions produced at different times of a typical winter's day from home heating across various suburb areas of Christchurch.

Suburb Area	Area (ha)	6am-10am			10am-4pm			4pm-10pm			10pm-6am			Daily Total		
		kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total
Inner Suburb Study Area																
Beckenham/Sydenham	555	2	4	7	10	17	30	19	33	57	2	4	6	33	59	100
Fendalton	745	5	7	7	6	8	9	55	73	77	5	7	7	71	95	100
Inner City	635	0	1	2	4	6	15	21	34	80	1	2	4	27	42	100
Linwood	754	2	2	4	8	10	15	37	48	69	7	9	12	53	70	100
Opawa/Woolston	798	3	3	6	5	6	12	27	34	65	7	9	17	42	52	100
Riccarton	349	1	2	4	2	6	11	15	44	81	1	2	3	19	55	100
Shirley	572	3	6	9	5	9	14	23	39	61	6	11	17	37	65	100
Spreydon/Addington	745	4	6	6	9	12	12	51	68	70	9	12	12	73	98	100
St Albans	864	11	13	10	17	20	14	80	93	68	10	11	8	118	137	100
Sub-total - Inner Suburb Study Area	6016	32	5	7	66	11	14	327	54	69	47	8	10	472	79	100
Outer Suburbs																
Addington Industrial	230	0	1	6	0	1	11	2	9	70	0	2	12	3	12	100
Airport	2088	0	0	9	0	0	22	1	0	59	0	0	10	1	0	100
Avonhead	727	3	4	9	7	9	21	19	26	60	3	4	10	31	43	100
Bishopdale	887	3	4	9	5	5	14	23	26	68	3	3	9	34	38	100
Bromley	764	1	1	8	1	1	7	8	10	66	2	3	19	12	16	100
Burnside/Bryndwr	460	4	8	5	10	23	15	44	96	63	12	26	17	70	153	100
Hoon Hay	421	3	8	7	9	21	19	26	61	56	8	19	18	46	109	100
Hornby	498	2	4	7	8	15	23	18	37	55	5	11	16	33	67	100
Marshlands	1135	1	1	7	3	2	30	5	4	57	1	0	6	9	8	100
New Avonhead	230	0	0	3	0	0	4	1	4	88	0	0	5	1	5	100
New Brighton	1942	11	6	8	11	6	7	96	49	65	29	15	20	147	76	100
Parklands	312	1	4	14	2	5	19	5	17	62	0	2	6	8	27	100
Racecourse	247	1	2	7	2	8	23	5	19	55	1	5	16	9	35	100
Redwood	752	2	3	7	10	13	30	18	25	57	2	3	6	32	43	100
Sockburn	264	1	6	7	5	19	23	12	47	55	4	14	16	23	85	100
Wigram	786	0	0	7	1	2	23	3	4	55	1	1	16	5	7	100
Sub-total	11741	34	3	7	72	6	16	286	24	61	72	6	16	465	40	100
Total - Total Study Area	17757	67	4	7	138	8	15	613	35	65	119	7	13	937	53	100

Table 3.15 SO_x emissions produced at different times of a typical winter's day from home heating across various suburb areas of Christchurch.

Suburb Area	Area (ha)	6am-10am			10am-4pm			4pm-10pm			10pm-6am			Daily Total		
		kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total
Inner Suburb Study Area																
Beckenham/Sydenham	555	5	10	7	9	16	12	59	106	80	0	1	1	73	132	100
Fendalton	745	26	35	10	24	33	9	200	269	77	9	12	3	259	348	100
Inner City	635	0	0	0	5	8	7	69	108	93	0	0	0	74	117	100
Linwood	754	0	0	0	23	31	18	102	136	81	1	1	1	127	168	100
Opawa/Woolston	798	1	1	1	4	5	7	50	62	83	5	7	9	60	75	100
Riccarton	349	7	20	10	14	39	19	45	129	61	8	23	11	73	211	100
Shirley	572	6	11	12	9	16	18	24	41	46	13	22	24	52	91	100
Spreydon/Addington	745	35	47	9	52	70	13	245	328	61	69	93	17	401	539	100
St Albans	864	13	15	7	19	22	11	140	162	80	2	2	1	173	201	100
Sub-total - Inner Suburb Study Area	6016	93	15	7	161	27	12	932	155	72	107	18	8	1293	215	100
Outer Suburbs																
Addington Industrial	230	1	6	9	2	9	13	10	43	61	3	12	17	16	71	100
Airport	2088	0	0	10	1	1	31	2	1	48	0	0	11	4	2	100
Avonhead	727	14	19	10	43	59	31	67	93	48	15	21	11	140	192	100
Bishopdale	887	4	4	7	5	6	11	39	44	80	0	1	1	48	54	100
Bromley	764	2	3	10	2	3	9	15	19	60	5	6	20	24	32	100
Burnside/Bryndwr	460	17	38	8	28	62	14	114	247	55	48	105	23	208	452	100
Hoon Hay	421	5	11	8	13	31	23	32	76	56	8	18	13	58	137	100
Hornby	498	4	9	3	36	72	26	78	157	58	17	34	13	136	272	100
Marshlands	1135	1	1	7	2	2	12	16	14	80	0	0	1	20	18	100
New Avonhead	230	0	0	4	0	0	6	0	1	81	0	0	8	0	1	100
New Brighton	1942	30	16	10	28	14	9	182	94	60	61	32	20	301	155	100
Parklands	312	4	13	24	6	20	36	7	22	39	0	0	1	17	55	100
Racecourse	247	1	5	3	10	39	26	21	85	58	5	19	13	36	147	100
Redwood	752	5	7	7	9	12	12	59	78	80	0	1	1	73	97	100
Sockburn	264	3	11	3	24	92	26	53	201	58	12	44	13	92	347	100
Wigram	786	1	1	3	6	8	26	13	17	58	3	4	13	23	29	100
Sub-total	11741	94	8	8	216	18	18	708	60	59	178	15	15	1197	102	100
Total - Total Study Area	17757	187	11	8	377	21	15	1640	92	66	286	16	11	2490	140	100

Table 3.16 VOC emissions produced at different times of a typical winter's day from home heating across various suburb areas of Christchurch.

Suburb Area	Area (ha)	6am-10am			10am-4pm			4pm-10pm			10pm-6am			Daily Total		
		kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total
Inner Suburb Study Area																
Beckenham/Sydenham	555	41	73	7	170	307	31	298	538	55	36	64	7	545	982	100
Fendalton	745	74	100	7	100	134	9	863	1159	77	91	122	8	1128	1514	100
Inner City	635	8	12	2	69	108	16	344	542	78	21	33	5	441	695	100
Linwood	754	34	44	4	124	165	14	600	796	68	119	157	14	877	1163	100
Opawa/Woolston	798	48	60	7	90	113	12	458	574	64	124	156	17	720	902	100
Riccarton	349	11	30	3	32	92	11	254	726	84	6	18	2	303	867	100
Shirley	572	57	100	9	86	151	13	396	693	62	104	182	16	644	1126	100
Spreydon/Addington	745	59	79	6	126	169	12	765	1027	72	118	159	11	1068	1435	100
St Albans	864	198	230	10	297	344	15	1375	1592	67	175	203	9	2046	2368	100
Sub-total - Inner Suburb Study Area	6016	529	88	7	1094	182	14	5353	890	69	794	132	10	7772	1292	100
Outer Suburbs																
Addington Industrial	230	2	10	6	5	20	11	29	128	72	5	20	11	41	178	100
Airport	2088	1	1	9	3	1	20	9	4	61	1	1	10	14	7	100
Avonhead	727	42	58	9	93	128	19	297	408	62	45	62	9	477	656	100
Bishopdale	887	55	62	9	83	93	14	389	439	67	56	63	10	583	657	100
Bromley	764	15	20	7	14	19	7	137	180	67	39	52	19	206	269	100
Burnside/Bryndwr	460	58	125	5	172	375	15	731	1592	64	190	413	16	1151	2504	100
Hoon Hay	421	59	140	7	151	357	19	446	1059	56	145	344	18	800	1900	100
Hornby	498	38	75	7	115	230	22	282	567	54	85	170	16	519	1042	100
Marshlands	1135	11	10	7	47	41	31	82	72	55	10	9	7	150	132	100
New Avonhead	230	1	2	3	1	3	4	18	78	88	1	4	5	20	88	100
New Brighton	1942	186	96	7	178	92	7	1651	850	66	490	253	20	2506	1291	100
Parklands	312	18	59	13	25	79	17	91	290	63	9	29	6	143	457	100
Racecourse	247	9	38	7	30	121	22	72	292	54	22	88	16	133	539	100
Redwood	752	40	54	7	169	225	31	297	395	55	36	47	7	542	722	100
Sockburn	264	25	95	7	77	292	22	191	721	54	57	217	16	350	1325	100
Wigram	786	6	8	7	19	24	22	45	57	54	14	17	16	83	106	100
Sub-total	11741	568	48	7	1180	100	15	4768	406	62	1204	103	16	7719	657	100
Total - Total Study Area	17757	1097	62	7	2274	128	15	10121	570	65	1998	113	13	15490	872	100

Table 3.17 CO_2 emissions produced at different times of a typical winter's day from home heating across various suburb areas of Christchurch.

Suburb Area	Area (ha)	6am-10am			10am-4pm			4pm-10pm			10pm-6am			Daily Total		
		kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total
Inner Suburb Study Area																
Beckenham/Sydenham	555	3245	5850	8	11057	19933	26	25410	45809	59	3307	5962	8	43019	77554	100
Fendalton	745	8406	11283	8	10406	13967	10	75610	101490	73	8918	11970	9	103340	138711	100
Inner City	635	550	867	2	5026	7919	14	27834	43860	79	1801	2839	5	35211	55486	100
Linwood	754	2973	3943	4	10779	14297	15	51993	68965	71	7762	10296	11	73506	97501	100
Opawa/Woolston	798	4421	5538	7	7861	9848	13	38989	48840	64	9774	12243	16	61045	76469	100
Riccarton	349	1531	4387	5	4397	12598	16	21085	60417	75	1235	3540	4	28248	80941	100
Shirley	572	4797	8381	9	7195	12572	13	32528	56837	60	10066	17589	18	54586	95380	100
Spreydon/Addington	745	7776	10443	7	15088	20263	13	78262	105106	67	15551	20886	13	116677	156697	100
St Albans	864	15916	18427	10	23873	27641	14	111847	129498	67	14202	16443	9	165838	192009	100
Sub-total - Inner Suburb Study Area	6016	49614	8247	7	95681	15904	14	463559	77053	68	72616	12070	11	681470	113274	100
Outer Suburbs																
Addington Industrial	230	317	1381	7	617	2690	13	3162	13776	67	634	2762	13	4730	20609	100
Airport	2088	146	70	10	350	168	23	870	417	57	157	75	10	1524	730	100
Avonhead	727	4661	6415	10	11172	15376	23	27745	38185	57	5020	6909	10	48598	66884	100
Bishopdale	887	4420	4985	10	6629	7478	14	31058	35035	67	3944	4448	9	46051	51947	100
Bromley	764	1363	1784	7	1526	1998	8	12019	15732	66	3342	4374	18	18250	23888	100
Burnside/Bryndwr	460	7177	15620	7	16653	36242	16	60086	130764	58	19279	41956	19	103195	224582	100
Hoon Hay	421	4792	11373	7	11774	27939	18	38256	90782	57	12206	28966	18	67028	159060	100
Hornby	498	3419	6864	7	11891	23872	23	28233	56681	55	7552	15161	15	51094	102579	100
Marshlands	1135	894	788	8	3047	2684	26	7002	6167	59	911	803	8	11854	10441	100
New Avonhead	230	75	324	4	112	486	6	1454	6320	81	149	648	8	1789	7778	100
New Brighton	1942	16887	8697	7	18908	9738	8	148882	76680	66	41392	21319	18	226068	116434	100
Parklands	312	2274	7284	16	3055	9785	21	8020	25688	55	1188	3804	8	14536	46561	100
Racecourse	247	915	3699	7	3182	12863	23	7556	30542	55	2021	8170	15	13675	55274	100
Redwood	752	3232	4301	8	11013	14655	26	25310	33679	59	3294	4383	8	42849	57018	100
Sockburn	264	2312	8753	7	8043	30441	23	19096	72278	55	5108	19333	15	34559	130806	100
Wigram	786	574	731	7	1997	2542	23	4742	6037	55	1269	1615	15	8582	10925	100
Sub-total	11741	53459	4553	8	109970	9366	16	423489	36069	61	107465	9153	15	694383	59142	100
Total - Total Study Area	17757	103073	5805	7	205651	11581	15	887048	49955	64	180081	10141	13	1375853	77482	100

4. Motor Vehicle Emissions

4.1. Motor Vehicle Emission Factors, Calculation Techniques and Assumptions

To calculate emissions from motor vehicles, it was first necessary to develop emission factors, calculate vehicle kilometres travelled (VKT's), and estimate average driving speeds for each of the study areas.

The motor vehicle emissions factors used in this inventory (Table 4.1, Table 4.2, and Table 4.3) were developed from a literature survey (United States Environmental Protection Agency (USEPA) (1994), Economopoulos (1993), International Panel on Climate Change (1995), and Gas Association of New Zealand Incorporated (1995)).

In order to account for the effect of differing driving speeds, three regimes were adopted. For suburbs with average driving speeds up to 35 km/h, an "urban" driving regime was used to calculate emissions (Table 4.1). For suburbs with average driving speeds in the range 36-70 km/h, a "suburban" driving regime was applied (Table 4.2), and for suburbs with average driving speeds over 71 km/h a "highway" driving regime was used (Table 4.3).

Table 4.1 Vehicle distribution and emission factors per kilometre driven - Urban.

		Total Emissions per km Driven (g)					
Vehicle Type	Fleet (%)	PM_{10}	CO	NO_x	SO_x	VOC	CO_2
Light duty <3.5t **petrol** vehicles	82.30	0.07	21.58	1.93	0.01	4.42	334.00
Light duty <3.5t **diesel** vehicles	4.10	0.15	0.85	0.55	0.20	0.40	400.00
Light duty <3.5t **LPG/CNG** vehicles	2.70	0.00	1.42	1.78	0.00	1.76	290.00
Heavy duty >3.5t **petrol** vehicles	1.60	0.40	70.00	4.50	0.03	7.00	850.00
Heavy duty >3.5t **diesel** vehicles	8.40	1.52	7.03	17.55	1.68	5.61	1000.00
Heavy duty >3.5t **LPG/CNG** vehicles	0.20	0.00	18.86	5.70	0.00	9.69	969.00
2&4 stroke **petrol** motorcycles	0.70	0.07	18.80	0.16	0.16	8.40	93.00
Weighted fleet emission factors	100.00	0.198	19.71	3.22	0.16	4.36	399.00

Table 4.2 Vehicle distribution and emission factors per km driven - Suburban.

		Total Emissions per km Driven (g)					
Vehicle Type	Fleet (%)	PM_{10}	CO	NO_x	SO_x	VOC	CO_2
Light duty <3.5t **petrol** vehicles	82.30	0.05	9.88	2.46	0.01	2.80	334.00
Light duty <3.5t **diesel** vehicles	4.10	0.15	0.85	0.55	0.20	0.40	400.00
Light duty <3.5t **LPG/CNG** vehicles	2.70	0.00	0.84	1.80	0.00	1.68	290.00
Heavy duty >3.5t **petrol** vehicles	1.60	0.45	55.00	7.50	0.02	5.50	850.00
Heavy duty >3.5t **diesel** vehicles	8.40	1.45	3.36	21.85	1.62	2.70	1000.00
Heavy duty >3.5t **LPG/CNG** vehicles	0.20	0.00	18.86	5.70	0.00	9.69	969.00
2&4 stroke **petrol** motorcycles	0.70	0.07	18.80	0.16	0.62	8.40	93.00
Weighted fleet emission factors	100.00	0.18	9.52	4.06	0.15	2.76	399.00

Table 4.3 Vehicle distribution and emission factors per km driven - Highway.

		Total Emissions per km Driven (g)					
Vehicle Type	Fleet (%)	PM_{10}	CO	NO_x	SO_x	VOC	CO_2
Light duty <3.5t **petrol** vehicles	82.30	0.05	7.05	3.37	0.01	2.20	334.00
Light duty <3.5t **diesel** vehicles	4.10	0.15	0.85	0.55	0.20	0.40	400.00
Light duty <3.5t **LPG/CNG** vehicles	2.70	0.00	0.61	2.34	0.00	1.63	290.00
Heavy duty >3.5t **petrol** vehicles	1.60	0.60	50.00	7.50	0.02	3.50	850.00
Heavy duty >3.5t **diesel** vehicles	8.40	1.15	2.72	17.55	1.47	2.13	1000.00
Heavy duty >3.5t **LPG/CNG** vehicles	0.20	0.00	18.86	5.70	0.00	9.69	969.00
2&4 stroke **petrol** motorcycles	0.70	0.07	18.80	0.16	0.62	8.40	93.00
Weighted fleet emission factors	100.00	0.15	7.05	4.47	0.14	2.18	399.00

The factors in Table 4.1, Table 4.2 and Table 4.3 reflect the differences in emissions from the various vehicle types. Take PM_{10} and NO_x for example, when compared to light duty <3.5t petrol vehicles on an individual basis:

- light duty <3.5t diesel vehicles produce at least twice as much PM_{10};
- heavy duty >3.5t petrol vehicles produce 6-12 times the quantity of PM_{10} and 2-3 times the amount of NO_x;
- heavy duty >3.5t diesel vehicles produce 22-29 times the amount of PM_{10} and 5-9 times the amount of NO_x;
- heavy duty >3.5t LPG/CNG vehicles produce 2-3 times more NO_x and;
- 2 & 4 stroke petrol motorcycles produce 1.4 times the amount of PM_{10}.

With the fleet composition taken into consideration, the pattern is somewhat different. For example, light duty <3.5t petrol vehicles (which represent 82% of the vehicle fleet) produce:

- ~9.5 times more PM_{10} and 70-123 times more NO_x than light duty <3.5t diesel vehicles;
- 33-44 times more NO_x than light duty <3.5t LPG/CNG vehicles;
- 17-23 times more NO_x and 4-9 times more PM_{10} than heavy duty >3.5t petrol vehicles;
- 1-2 times more NO_x than heavy duty >3.5t diesel vehicles;
- 139-243 times more NO_x than heavy duty >3.5t LPG/CNG vehicles and;
- 84-118 times more PM_{10} and 1418-2476 times more NO_x than 2 & 4 stroke petrol motorcycles.

Likewise, heavy duty >3.5t diesel vehicles, which represent 8.4% of the vehicle fleet, produce:

- 2-3 times more PM_{10} than light duty <3.5t petrol vehicles;
- 16-21 times more PM_{10} and 65-81 times more NO_x than light duty <3.5t diesel vehicles;
- 23-38 times more NO_x than light duty <3.5t LPG/CNG vehicles and;
- 10-20 times more PM_{10} and 12-21 times more NO_x than heavy duty >3.5t petrol vehicles.

The Canterbury Regional Council supplied the average number of vehicle kilometres travelled per day (VKT's) and the average driving speeds for each study area. From this information, driving regimes could be designated to various suburb areas (Table 4.4).

Motor vehicle emissions were then calculated for a typical winter's day and aggregated to a total using the following formula:

$$\textit{Motor Vehicle Emissions (g)} = \textit{Driving Regime Emission Factor(g/km)} * \textit{VKT (km)}$$

So, to calculate total PM_{10} emissions from all vehicle types within the "urban" area of Addington Industrial the equation would look like:

$$PM_{10}\ \textit{Emissions (g)} = 0.198\ \textit{g/km} * 124767\ \textit{km}$$

The aggregated total motor vehicle emissions were then divided by the number of hectares within each suburb area (1 hectare = $10000m^2$). This gave a "normalised" weight per area value (e.g. grams per hectare) and allowed fair comparison between differently-sized study areas.

The following assumptions were also made:

1. Typical NZ fuel information is:
   unleaded 91: 47.9% sales Lead (Pb)=0.001 g/l Sulphur (S)=0.005 wt%
   leaded 96: 52.1% sales Lead (Pb)=0.268 g/l Sulphur (S)=0.007 wt%
   diesel Lead (Pb)=0.000 g/l Sulphur (S)=0.240 wt%
2. Fuel technology for NZ cars is:
   70% carburettors
   30% fuel injectors
3. Motorcycle fleet breakdown is:
   <50cc 2-stroke 20%
   >50cc 2-stroke 40%
   >50cc 4-stroke 40%

The emissions factors for heavy duty LPG/CNG vehicles have been developed from fewer sets of data as there is very little information currently available.

Table 4.4 Average speed and vehicle kilometres travelled at different times of a typical winter's day for various study areas of Christchurch.

Suburb Area	Average Speed Regime				Vehicle Kilometres Travelled (km)			
	6am-10am	10am-4pm	4pm-10pm	10pm-6am	6am-10am	10am-4pm	4pm-10pm	10pm-6am
Inner Suburb Study Area								
Beckenham/Sydenham	urban	urban	urban	suburban	88411	183210	117750	19783
Fendalton	urban	urban	urban	urban	72921	148671	97965	16968
Inner City	urban	urban	urban	urban	163340	337974	205017	34836
Linwood	urban	urban	urban	urban	105831	215571	144353	24670
Opawa/Woolston	urban	urban	urban	suburban	89450	185619	119317	20064
Riccarton	urban	urban	urban	urban	70289	145392	87134	15485
Shirley	urban	urban	urban	urban	42701	88431	60436	9269
Spreydon/Addington	urban	urban	urban	urban	89609	185898	119327	20059
St Albans	urban	urban	urban	urban	95434	196410	129456	22061
Sub-total -Inner Suburb Study Area	urban	urban	urban	urban	817983	1687176	1080755	183192
Outer Suburbs								
Addington Industrial	urban	urban	urban	urban	27496	57600	33690	5981
Airport	suburban	suburban	suburban	suburban	50183	97062	65149	11356
Avonhead	urban	urban	urban	suburban	112002	228402	147799	24637
Bishopdale	urban	urban	urban	urban	36519	71301	48100	8208
Bromley	suburban	suburban	suburban	suburban	37853	75324	50825	8333
Burnside/Bryndwr	urban	urban	urban	suburban	42812	88662	58855	9883
Hoon Hay	suburban	suburban	urban	suburban	37820	77757	52643	8431
Hornby	urban	urban	urban	suburban	40056	81363	50343	8755
Marshlands	suburban	suburban	suburban	suburban	56390	115341	77860	12720
New Avonhead	urban	urban	urban	urban	132	315	228	98
New Brighton	urban	urban	urban	suburban	91223	187704	130541	21351
Parklands	urban	urban	urban	suburban	12508	25494	17892	2775
Racecourse	highway	highway	highway	highway	6159	14397	10397	3280
Redwood	urban	urban	suburban	urban	56139	114444	75534	12858
Sockburn	urban	urban	urban	urban	44654	91476	56414	9983
Wigram	suburban	suburban	suburban	suburban	54308	111462	69342	11907
Sub-total	suburban	suburban	suburban	suburban	706250	1438104	945612	160553
Total - Total Study Area	urban	urban	urban	suburban	1524233	3125280	2026367	343745

4.2. Motor Vehicle Emissions on a Typical Winter's Day by Vehicle Type

In both the total study area and the inner suburb area, light duty petrol and heavy duty diesel vehicles tend to emit larger quantities of all six pollutants under study (Figure 4.1 , Table 4.5, and Table 4.6).

Light duty petrol vehicles are the main emitters of CO (~90%), VOC (83%) and CO_2 (~70%). Heavy duty diesel vehicles tend to emit larger quantities of PM_{10} (65%) and SO_x (87%). A further 20% of CO_2 emissions stem from heavy duty diesel vehicles while nearly 30% of PM_{10} emissions are derived from light duty petrol vehicles. Both light duty petrol vehicles and heavy duty diesel vehicles release similar quantities of NO_x (50% and 46% respectively).

Even though the percentage of emissions by vehicle types are very similar for both the total study area and the inner suburb area, estimated quantities released (per day and per hectare) are quite different. On average, the inner suburb area produces 1.5-1.75 times the amount of all six pollutants per hectare per day when compared to the quantities produced by the total study area. Individual suburb results can be found in Appendix III.

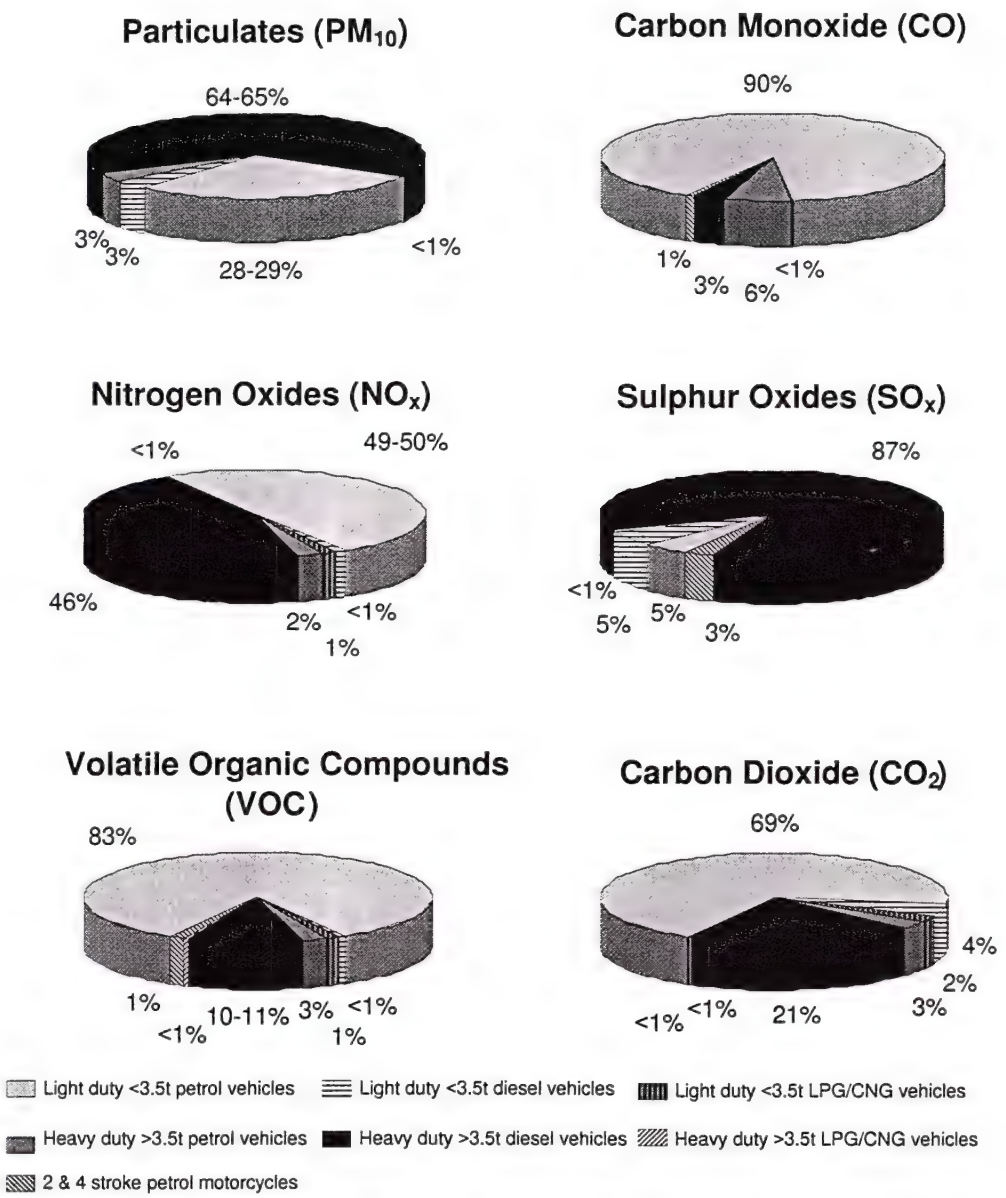


Figure 4.1 Emissions by vehicle type for the total study area and the inner suburb study area.

Table 4.5 Emissions by vehicle type for the total study area.

	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Light duty <3.5t petrol vehicles	384	22	28	112589	6341	90	11719	660	50	54	3	5	23856	1343	83	1929568	108665	69
Light duty <3.5t diesel vehicles	43	2	3	245	14	0	158	9	1	58	3	5	115	6	0	115122	6483	4
Light duty <3.5t LPG/CNG vehicles	0	0	0	249	14	0	339	19	1	0	0	0	331	19	1	54964	3095	2
Heavy duty >3.5t petrol vehicles	46	3	3	7560	426	6	565	32	2	3	0	0	755	43	3	95467	5376	3
Heavy duty >3.5t diesel vehicles	888	50	65	3759	212	3	10786	607	46	985	55	87	3002	169	10	589648	33206	21
Heavy duty >3.5t LPG/CNG vehicles	0	0	0	265	15	0	80	5	0	0	0	0	136	8	0	13604	766	0
2&4 stroke petrol motorcycles	3	0	0	924	52	1	8	0	0	30	2	3	413	23	1	4570	257	0
Total	1365	77	100	125591	7073	100	23655	1332	100	1130	64	100	28608	1611	100	2802943	157849	100

Table 4.6 Emissions by vehicle type for the inner suburb study area.

	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Light duty <3.5t petrol vehicles	216	36	29	66557	11063	90	6004	998	49	31	5	5	13658	2270	83	1036059	172214	69
Light duty <3.5t diesel vehicles	23	4	3	131	22	0	85	14	1	31	5	5	62	10	0	61813	10275	4
Light duty <3.5t LPG/CNG vehicles	0	0	0	144	24	0	181	30	1	0	0	0	179	30	1	29512	4906	2
Heavy duty >3.5t petrol vehicles	24	4	3	4212	700	6	273	45	2	2	0	0	421	70	3	51260	8520	3
Heavy duty >3.5t diesel vehicles	481	80	64	2213	368	3	5571	926	46	533	89	87	1766	294	11	316605	52626	21
Heavy duty >3.5t LPG/CNG vehicles	0	0	0	142	24	0	43	7	0	0	0	0	73	12	0	7305	1214	0
2&4 stroke petrol motorcycles	2	0	0	496	82	1	4	1	0	16	3	3	222	37	1	2454	408	0
Total	747	124	100	73896	12283	100	12162	2022	100	613	102	100	16381	2723	100	1505008	250163	100

4.3. Motor Vehicle Emissions on a Typical Winter's Day - Total

Motor vehicle emissions to the air on a typical winter's day for various study areas of Christchurch are presented in Table 4.7 over.

The total study area is estimated to produce approximately 1365 kilograms of PM_{10} per day or 77 grams per hectare per day whereas the inner suburb study area is estimated to produce 55% of the total PM_{10} emissions (747 kg/day) (Table 4.7). On a grams per hectare basis, the PM_{10} emissions from motor vehicles within the inner suburb study area are 1.6 times greater than the total study area (124 g/ha/day compared to 77 g/ha/day).

A similar pattern emerges when examining the CO, NO_x, SO_x, VOC and CO_2 emissions from motor vehicles (Table 4.7). The inner suburb study area is estimated to produce nearly 60% of the total CO and NO_x emissions, 54% of the total SO_x and CO_2 emissions and 51% of the total NO_x emissions. On a grams per hectare basis, the inner suburb study area produces 1.5 times more NO_x than the total study area, 1.6 times more SO_x and CO_2 and 1.7 times the CO and VOC.

On an individual suburb basis (Table 4.7), motor vehicle emissions vary considerably from suburb to suburb. For example, when comparing New Avonhead (the suburb with the lowest total and grams per hectare pollutant emissions) with the Inner City (the suburb with the highest total and grams per hectare pollutant emissions), PM_{10} emissions per hectare in the Inner City are approximately 230 times larger than those in New Avonhead. CO and CO_2 can be as much as 350 times larger, NO_x and VOC 340 times larger, and SO_x 190 times greater.

Results indicate that pollutant emissions are largely determined by the number of major traffic routes within a study area, the traffic density, the number of VKT's, and driving speeds. Suburb areas with little or no major traffic routes (such as New Avonhead, Parklands and the Racecourse) generally display lower VKT's and are commonly in the "urban" and/or "suburban" driving regimes (Table 4.8). As a result, these areas tend to exhibit lower pollutant emissions per day. It is likely that the traffic in these areas is primarily associated with local residents commuting to and from their homes to places of employment, recreation, education, shopping and entertainment but *within* their suburb boundaries. On the other hand, suburbs with greater traffic densities and hence higher VKT's (such as the Inner City, Avonhead, Linwood, and St Albans) display high emissions of all six pollutants under study. In these cases, more traffic is likely to *cross* suburb boundaries, and travel at slower speeds.

Motor vehicle emissions tend to be highest close to traffic routes and decrease exponentially in concentration as distance from the roading system increases. For this reason, the total daily PM_{10}, CO, NO_x, SO_x, VOC and CO_2 emissions from motor vehicles are more likely to be localised around the traffic routes instead of being uniform across the suburb area (as with home heating emissions). Emissions per hectare standardise the localised total daily emissions across the entire suburb area. It is assumed that the inner city is an exception to this in that motor vehicle emissions are expected to be relatively uniform throughout the area.

Table 4.7 Typical winter's day emissions from motor vehicles for various study areas of Christchurch.

Suburb Area	Area (ha)	PM_{10} kg	PM_{10} % Total	PM_{10} g/ha	CO kg	CO % Total	CO g/ha	NO_x kg	NO_x % Total	NO_x g/ha	SO_x kg	SO_x % Total	SO_x g/ha	VOC kg	VOC % Total	VOC g/ha	CO_2 kg	CO_2 % Total	CO_2 g/ha
Inner Suburb Study Area																			
Beckenham/Sydenham	555	81	6	146	7864	6	14177	1333	6	2404	66	6	120	1753	6	3161	163375	6	294529
Fendalton	745	67	5	90	6634	5	8905	1083	5	1453	55	5	73	1468	5	1971	134375	5	180369
Inner City	635	147	11	232	14611	12	23024	2385	10	3758	121	11	190	3234	11	5096	295948	11	466354
Linwood	754	97	7	129	9668	8	12824	1578	7	2093	80	7	106	2140	7	2838	195827	7	259752
Opawa/Woolston	798	82	6	102	7966	6	9978	1351	6	1692	67	6	84	1776	6	2225	165490	6	207303
Riccarton	349	63	5	181	6275	5	17979	1024	4	2935	52	5	148	1389	5	3979	127098	5	364176
Shirley	572	40	3	70	3959	3	6918	646	3	1129	33	3	57	876	3	1531	80194	3	140126
Spreydon/Addington	745	82	6	111	8179	7	10984	1335	6	1793	67	6	91	1810	6	2431	165667	6	222491
St Albans	864	88	6	102	8740	7	10119	1427	6	1652	72	6	83	1934	7	2240	177034	6	204972
Sub-total - Inner Suburb Study Area	6016	747	55	124	73896	59	12283	12162	51	2022	613	54	102	16381	57	2723	1505008	54	250168
Outer Suburbs																			
Addington Industrial	230	25	2	108	2460	2	10717	401	2	1749	20	2	88	544	2	2372	49819	2	217078
Airport	2088	40	3	19	2130	2	1020	909	4	436	34	3	16	617	2	296	89343	3	42797
Avonhead	727	101	7	139	9859	8	13568	1671	7	2300	83	7	114	2198	8	3025	204777	7	281830
Bishopdale	887	33	2	37	3236	3	3650	528	2	596	27	2	30	716	3	808	65536	2	73927
Bromley	764	30	2	40	1641	1	2147	700	3	917	27	2	35	475	2	622	68813	2	90070
Burnside/Bryndwr	460	39	3	86	3846	3	8370	653	3	1420	32	3	71	858	3	1867	79945	3	173982
Hoon Hay	421	32	2	77	2218	2	5264	673	3	1598	28	2	66	572	2	1357	70537	3	167387
Hornby	498	36	3	71	3469	3	6965	588	2	1181	29	3	59	774	3	1553	72080	3	144710
Marshlands	1135	46	3	41	2497	2	2200	1066	5	939	40	4	36	724	3	637	104741	4	92258
New Avonhead	230	0	0	1	15	0	66	2	0	11	0	0	1	3	0	15	308	0	1341
New Brighton	1942	85	6	44	8275	7	4262	1404	6	723	70	6	36	1845	6	950	172026	6	88600
Parklands	312	12	1	37	1128	1	3614	191	1	612	10	1	30	252	1	806	23427	1	75037
Racecourse	247	5	0	21	241	0	976	153	1	618	5	0	20	75	0	302	13669	0	55250
Redwood	752	50	4	66	4335	3	5769	897	4	1194	41	4	55	1009	4	1342	103409	4	137603
Sockburn	264	40	3	152	3992	3	15112	652	3	2467	33	3	125	884	3	3345	80869	3	306090
Wigram	786	44	3	56	2352	2	2994	1004	4	1278	38	3	48	682	2	868	98635	4	125553
Sub-total	11741	618	45	53	51695	41	4403	11494	49	979	518	46	44	12227	43	1041	1297935	46	110547
Total - Total Study Area	17757	1365	100	77	125591	100	7073	23655	100	1332	1130	100	64	28608	100	1611	2802943	100	157850

Table 4.8 Typical winter's day emissions from motor vehicles in descending order of PM_{10} for the 25 suburb areas of Christchurch.

Suburb Area	Daily VKT's	Pollutant (g/day)					
		PM_{10}	CO	NO_x	SO_x	VOC	CO_2
Inner City	741166	146995	14610880	2384865	120534	3233707	295948325
Avonhead	512840	101181	9858674	1671015	83185	2198005	204777325
Linwood	490425	97266	9667920	1578049	79757	2139722	195826993
St. Albans	443360	87932	8740120	1426608	72103	1934380	177034091
New Brighton	430819	84984	8275253	1404315	69875	1845417	172026258
Spreydon/Addington	414892	82286	8178920	1335006	67473	1810174	165666790
Opawa/Woolston	414450	81766	7965683	1350555	67224	1776063	165490100
Beckenham/Sydenham	409153	80721	7864141	1333274	66365	1753406	163375202
Fendalton	336525	66743	6634032	1082842	54728	1468256	134374569
Riccarton	318300	63128	6274766	1024200	51764	1388743	127097508
Redwood	258975	49735	4335339	897204	41451	1008760	103408777
Marshlands	262311	46374	2497283	1065938	40347	723751	104740845
Wigram	247019	43670	2351698	1003797	37994	681559	98634734
Sockburn	202527	40167	3992480	651674	32936	883623	80869034
Shirley	200837	39832	3959164	646236	32662	876250	80194215
Airport	223749	39557	2130164	909238	34415	617355	89343199
Burnside/Bryndwr	200212	39495	3846115	652586	32473	857674	79944852
Hornby	180516	35613	3469344	588256	29280	773550	72080219
Bishopdale	164128	32551	3235506	528116	26692	716088	65536275
Hoon Hay	176651	32364	2218368	673316	27635	571837	70536921
Bromley	172335	30467	1640681	700307	26507	475495	68813338
Addington Industrial	124767	24745	2459568	401464	20291	544356	49819388
Parklands	58669	11576	1128278	191128	9517	251522	23426590
Racecourse	34232	5271	241379	152879	4855	74766	13668872
New Avonhead	773	153	15229	2486	126	3370	308460
Average	280785	54583	5023639	946214	45208	1144313	112117715
Median	247019	43670	3959164	909238	37994	876250	98634734

4.4. Motor Vehicle Emissions by Time of Day

On average, approximately 45% of all motor vehicle emissions of PM_{10}, CO, NO_x, SO_x, VOC and CO_2 are released between the hours of 10am-4pm across the total study area (Figure 4.2 and Table 4.9). A secondary peak occurs between 4pm-10pm, during which ~30% of contaminants are emitted. A further 22% of pollutants are emitted between 6am-10am. Only 4-5% of all pollutants are emitted overnight (between 10pm-6am). This pattern is also a similar feature of the inner suburb area across all six pollutants, as well as in the majority of individual suburbs (Table 4.10, Table 4.11-Table 4.16).

Again the average estimated emissions per hectare from the inner suburb area are 1.5-1.75 times the emissions of the total study area for all six pollutants.

Actual traffic flow between 6am and 4pm may give some insight as to why the peak occurs between 10am-4pm and not 6am-10am as could be expected. Morning "rush hour" traffic is often erratic and dependent on a number of variables (e.g. weather conditions). Because of this it may only account for a portion of the 6am-10am time frame. Traffic flow between 10am-4pm is more likely to be constant. There are also an extra two hours included in the time frame.

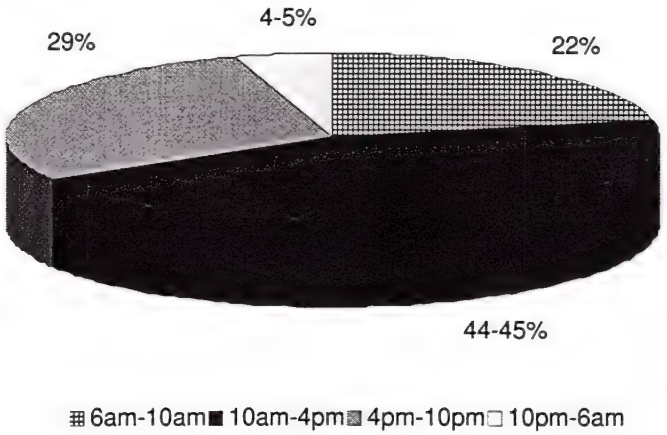


Figure 4.2 Breakdown of motor vehicle emissions for different times of a typical winter's day for the total study area and the inner suburb study area.

Table 4.9 Estimated motor vehicle emissions for various times of a typical winter's day across the total study area.

	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
6am-10am	297	17	22	27559	1552	22	5112	288	22	246	14	22	6257	352	22	608628	34275	22
10am-4pm	609	34	45	56566	3186	45	10478	590	44	504	28	45	12839	723	45	1247927	70278	45
4pm-10pm	394	22	29	36362	2048	29	6820	384	29	326	18	29	8275	466	29	809130	45567	29
10pm-6am	65	4	5	5104	287	4	1246	70	5	54	3	5	1236	70	4	137258	7730	5
Total	1365	77	100	125591	7073	100	23655	1332	100	1130	64	100	28608	1611	100	2802943	157849	100

Table 4.10 Estimated motor vehicle emissions for various times of a typical winter's day across the inner suburb study area.

	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
6am-10am	162	27	22	16125	2680	22	2632	437	22	133	22	22	3569	593	22	326621	54291	22
10am-4pm	335	56	45	33260	5528	45	5429	902	45	274	46	45	7361	1224	45	673691	111981	45
4pm-10pm	214	36	29	21305	3541	29	3478	578	29	176	29	29	4715	784	29	431547	71732	29
10pm-6am	35	6	5	3205	533	4	623	104	5	29	5	5	735	122	4	73149	12159	5
Total	747	124	100	73896	12283	100	12162	2022	100	613	102	100	16381	2723	100	1505008	250163	100

Table 4.11 PM_{10} emissions produced at different times of a typical winter's day by motor vehicles across various suburb areas of Christchurch.

Suburb Area	Area (ha)	6am-10am			10am-4pm			4pm-10pm			10pm-6am			Daily Total		
		kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total
Inner Suburb Study Area																
Beckenham/Sydenham	555	18	32	22	36	65	45	23	42	29	3	6	4	81	145	100
Fendalton	745	14	19	22	29	40	44	19	26	29	3	5	5	67	90	100
Inner City	635	32	51	22	67	106	46	41	64	28	7	11	5	147	231	100
Linwood	754	21	28	22	43	57	44	29	38	29	5	6	5	97	129	100
Opawa/Woolston	798	18	22	22	37	46	45	24	30	29	4	4	4	82	102	100
Riccarton	349	14	40	22	29	83	46	17	50	27	3	9	5	63	181	100
Shirley	572	8	15	21	18	31	44	12	21	30	2	3	5	40	70	100
Spreydon/Addington	745	18	24	22	37	49	45	24	32	29	4	5	5	82	110	100
St Albans	864	19	22	22	39	45	44	26	30	29	4	5	5	88	102	100
Sub-total - Inner Suburb Study Area	6016	162	27	22	335	56	45	214	36	29	35	6	5	747	124	100
Outer Suburbs																
Addington Industrial	230	5	24	22	11	50	46	7	29	27	1	5	5	25	108	100
Airport	2088	9	4	22	17	8	43	12	6	29	2	1	5	40	19	100
Avonhead	727	22	31	22	45	62	45	29	40	29	4	6	4	101	139	100
Bishopdale	887	7	8	22	14	16	43	10	11	29	2	2	5	33	37	100
Bromley	764	7	9	22	13	17	44	9	12	29	1	2	5	30	40	100
Burnside/Bryndwr	460	8	18	21	18	38	45	12	25	30	2	4	4	39	86	100
Hoon Hay	421	7	16	21	14	33	42	10	25	32	1	4	5	32	77	100
Hornby	498	8	16	22	16	32	45	10	20	28	2	3	4	36	72	100
Marshlands	1135	10	9	21	20	18	44	14	12	30	2	2	5	46	41	100
New Avonhead	230	0	0	17	0	0	41	0	0	30	0	0	13	0	1	100
New Brighton	1942	18	9	21	37	19	44	26	13	30	4	2	4	85	44	100
Parklands	312	2	8	21	5	16	44	4	11	31	0	2	4	12	37	100
Racecourse	247	1	4	18	2	9	42	2	6	30	1	2	10	5	21	100
Redwood	752	11	15	22	23	30	46	13	18	27	3	3	5	50	66	100
Sockburn	264	9	34	22	18	69	45	11	42	28	2	7	5	40	152	100
Wigram	786	10	12	22	20	25	45	12	16	28	2	3	5	44	56	100
Sub-total	11741	135	11	22	274	23	44	180	15	29	29	2	5	618	53	100
Total - Total Study Area	17757	297	17	22	609	34	45	394	22	29	65	4	5	1365	77	100

Table 4.12 CO emissions produced at different times of a typical winter's day by motor vehicles across various suburb areas of Christchurch.

Suburb Area	Area (ha)	6am-10am			10am-4pm			4pm-10pm			10pm-6am			Daily Total		
		kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total
Inner Suburb Study Area																
Beckenham/Sydenham	555	1743	3140	22	3612	6508	46	2321	4182	30	188	339	2	7864	14170	100
Fendalton	745	1438	1930	22	2931	3934	44	1931	2592	29	334	449	5	6634	8905	100
Inner City	635	3220	5071	22	6663	10492	46	4042	6365	28	687	1081	5	14611	23009	100
Linwood	754	2086	2767	22	4250	5636	44	2846	3774	29	486	645	5	9668	12822	100
Opawa/Woolston	798	1763	2210	22	3659	4585	46	2352	2948	30	191	239	2	7966	9982	100
Riccarton	349	1386	3970	22	2866	8213	46	1718	4922	27	305	875	5	6275	17979	100
Shirley	572	842	1472	21	1743	3048	44	1191	2083	30	183	319	5	3959	6922	100
Spreydon/Addington	745	1766	2371	22	3665	4919	45	2352	3157	29	395	531	5	8179	10978	100
St Albans	864	1881	2177	22	3872	4481	44	2552	2954	29	435	503	5	8740	10116	100
Sub-total - Inner Suburb Study Area	6016	16125	2680	22	33260	5529	45	21305	3541	29	3205	533	4	73896	12283	100
Outer Suburbs																
Addington Industrial	230	542	2357	22	1135	4937	46	664	2888	27	118	513	5	2460	10694	100
Airport	2088	478	229	22	924	443	43	620	297	29	108	52	5	2130	1020	100
Avonhead	727	2208	3037	22	4503	6193	46	2914	4008	30	235	323	2	9859	13561	100
Bishopdale	887	720	812	22	1406	1585	43	948	1069	29	162	182	5	3236	3648	100
Bromley	764	360	472	22	717	939	44	484	633	29	79	104	5	1641	2147	100
Burnside/Bryndwr	460	844	1835	22	1748	3800	45	1160	2522	30	94	205	2	3846	8361	100
Hoon Hay	421	360	855	16	740	1758	33	1038	2465	47	80	191	4	2218	5269	100
Hornby	498	790	1586	23	1604	3221	46	992	1993	29	83	167	2	3469	6967	100
Marshlands	1135	537	473	21	1098	967	44	741	653	30	121	107	5	2497	2200	100
New Avonhead	230	3	11	17	6	27	41	4	20	30	2	8	13	15	66	100
New Brighton	1942	1798	926	22	3700	1905	45	2573	1325	31	203	105	2	8275	4261	100
Parklands	312	247	790	22	503	1611	45	353	1130	31	26	85	2	1128	3616	100
Racecourse	247	43	176	18	102	411	42	73	297	30	23	94	10	241	977	100
Redwood	752	542	721	22	1135	1510	46	664	883	27	118	157	5	2460	3271	100
Sockburn	264	880	3334	22	1803	6831	45	1112	4213	28	197	745	5	3992	15123	100
Wigram	786	517	658	22	1061	1350	45	660	840	28	113	144	5	2352	2992	100
Sub-total	11741	10869	926	22	22185	1890	45	15002	1278	30	1763	150	4	49820	4243	100
Total - Total Study Area	17757	26994	1520	22	55445	3122	45	36307	2045	29	4968	280	4	123715	6967	100

Table 4.13 NO_x emissions produced at different times of a typical winter's day by motor vehicles across various suburb areas of Christchurch.

Suburb Area	Area (ha)	6am-10am			10am-4pm			4pm-10pm			10pm-6am			Daily Total		
		kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total
Inner Suburb Study Area																
Beckenham/Sydenham	555	284	513	21	590	1062	44	379	683	28	80	145	6	1333	2402	100
Fendalton	745	235	315	22	478	642	44	315	423	29	55	73	5	1083	1453	100
Inner City	635	526	828	22	1088	1713	46	660	1039	28	112	177	5	2385	3756	100
Linwood	754	341	452	22	694	920	44	464	616	29	79	105	5	1578	2093	100
Opawa/Woolston	798	288	361	21	597	748	44	384	481	28	82	102	6	1351	1692	100
Riccarton	349	226	648	22	468	1340	46	280	803	27	50	143	5	1024	2935	100
Shirley	572	137	240	21	285	497	44	194	340	30	30	52	5	646	1130	100
Spreydon/Addington	745	288	387	22	598	803	45	384	515	29	65	87	5	1335	1792	100
St Albans	864	307	355	22	632	731	44	417	482	29	71	82	5	1427	1651	100
Sub-total - Inner Suburb Study Area	6016	2632	438	22	5429	902	45	3478	578	29	623	104	5	12162	2022	100
Outer Suburbs																
Addington Industrial	230	88	385	22	185	806	46	108	471	27	19	84	5	401	1745	100
Airport	2088	204	98	22	394	189	43	265	127	29	46	22	5	909	435	100
Avonhead	727	360	496	22	735	1011	44	476	654	28	100	138	6	1671	2299	100
Bishopdale	887	118	132	22	229	259	43	155	174	29	26	30	5	528	595	100
Bromley	764	154	201	22	306	401	44	207	270	29	34	44	5	700	917	100
Burnside/Bryndwr	460	138	299	21	285	620	44	189	412	29	40	87	6	653	1419	100
Hoon Hay	421	154	365	23	316	751	47	169	402	25	34	81	5	673	1599	100
Hornby	498	129	259	22	262	526	45	162	325	28	36	71	6	588	1181	100
Marshlands	1135	229	202	21	469	413	44	316	279	30	52	46	5	1066	939	100
New Avonhead	230	0	2	17	1	4	41	1	3	30	0	1	13	2	11	100
New Brighton	1942	294	151	21	604	311	43	420	216	30	87	45	6	1404	723	100
Parklands	312	40	129	21	82	263	43	58	185	30	11	36	6	191	613	100
Racecourse	247	28	111	18	64	260	42	46	188	30	15	59	10	153	619	100
Redwood	752	88	118	22	185	246	46	108	144	27	19	26	5	401	534	100
Sockburn	264	144	544	22	294	1115	45	182	688	28	32	122	5	652	2468	100
Wigram	786	221	281	22	453	576	45	282	359	28	48	62	5	1004	1277	100
Sub-total	11741	2388	203	22	4866	414	44	3144	268	29	600	51	5	10998	937	100
Total - Total Study Area	17757	5020	283	22	10295	580	44	6621	373	29	1223	69	5	23160	1304	100

Table 4.14 SO_x emissions produced at different times of a typical winter's day by motor vehicles across various suburb areas of Christchurch.

Suburb Area	Area (ha)	6am-10am			10am-4pm			4pm-10pm			10pm-6am			Daily Total		
		kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total
Inner Suburb Study Area																
Beckenham/Sydenham	555	14	26	22	30	54	45	19	35	29	3	5	5	66	120	100
Fendalton	745	12	16	22	24	32	44	16	21	29	3	4	5	55	73	100
Inner City	635	27	42	22	55	87	46	33	53	28	6	9	5	121	190	100
Linwood	754	17	23	22	35	46	44	23	31	29	4	5	5	80	106	100
Opawa/Woolston	798	15	18	22	30	38	45	19	24	29	3	4	5	67	84	100
Riccarton	349	11	33	22	24	68	46	14	41	27	3	7	5	52	148	100
Shirley	572	7	12	21	14	25	44	10	17	30	2	3	5	33	57	100
Spreydon/Addington	745	15	20	22	30	41	45	19	26	29	3	4	5	67	91	100
St Albans	864	16	18	22	32	37	44	21	24	29	4	4	5	72	83	100
Sub-total - Inner Suburb Study Area	6016	133	22	22	274	46	45	176	29	29	29	5	5	613	102	100
Outer Suburbs																
Addington Industrial	230	4	19	22	9	41	46	5	24	27	1	4	5	20	88	100
Airport	2088	8	4	22	15	7	43	10	5	29	2	1	5	34	16	100
Avonhead	727	18	25	22	37	51	45	24	33	29	4	5	5	83	114	100
Bishopdale	887	6	7	22	12	13	43	8	9	29	1	2	5	27	30	100
Bromley	764	6	8	22	12	15	44	8	10	29	1	2	5	27	35	100
Burnside/Bryndwr	460	7	15	21	14	31	44	10	21	29	2	3	5	32	71	100
Hoon Hay	421	6	14	21	12	28	43	9	20	31	1	3	5	28	66	100
Hornby	498	7	13	22	13	27	45	8	16	28	1	3	5	29	59	100
Marshlands	1135	9	8	21	18	16	44	12	11	30	2	2	5	40	36	100
New Avonhead	230	0	0	17	0	0	41	0	0	30	0	0	13	0	1	100
New Brighton	1942	15	8	21	31	16	44	21	11	30	3	2	5	70	36	100
Parklands	312	2	7	21	4	13	44	3	9	31	0	1	4	10	31	100
Racecourse	247	1	4	18	2	8	42	1	6	30	0	2	10	5	20	100
Redwood	752	4	6	22	9	12	46	5	7	27	1	1	5	20	27	100
Sockburn	264	7	28	22	15	56	45	9	35	28	2	6	5	33	125	100
Wigram	786	8	11	22	17	22	45	11	14	28	2	2	5	38	48	100
Sub-total	11741	108	9	22	220	19	44	144	12	29	24	2	5	496	42	100
Total - Total Study Area	17757	241	14	22	495	28	45	320	18	29	53	3	5	1109	62	100

Table 4.15 VOC emissions produced at different times of a typical winter's day by motor vehicles across various suburb areas of Christchurch.

Suburb Area	Area (ha)	6am-10am			10am-4pm			4pm-10pm			10pm-6am			Daily Total		
		kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total
Inner Suburb Study Area																
Beckenham/Sydenham	555	386	695	22	799	1440	46	514	926	29	55	98	3	1753	3159	100
Fendalton	745	318	427	22	649	871	44	427	574	29	74	99	5	1468	1971	100
Inner City	635	713	1122	22	1475	2322	46	894	1409	28	152	239	5	3234	5092	100
Linwood	754	462	612	22	941	1247	44	630	835	29	108	143	5	2140	2838	100
Opawa/Woolston	798	390	489	22	810	1015	46	521	652	29	55	69	3	1776	2226	100
Riccarton	349	307	879	22	634	1818	46	380	1089	27	68	194	5	1389	3979	100
Shirley	572	186	326	21	386	675	44	264	461	30	40	71	5	876	1532	100
Spreydon/Addington	745	391	525	22	811	1089	45	521	699	29	88	117	5	1810	2430	100
St Albans	864	416	482	22	857	992	44	565	654	29	96	111	5	1934	2239	100
Sub-total - Inner Suburb Study Area	6016	3569	593	22	7361	1224	45	4715	784	29	735	122	4	16381	2723	100
Outer Suburbs																
Addington Industrial	230	120	522	22	251	1093	46	147	639	27	26	113	5	544	2367	100
Airport	2088	138	66	22	268	128	43	180	86	29	31	15	5	617	296	100
Avonhead	727	489	672	22	997	1371	45	645	887	29	68	94	3	2198	3023	100
Bishopdale	887	159	180	22	311	351	43	210	237	29	36	40	5	716	807	100
Bromley	764	104	137	22	208	272	44	140	184	29	23	30	5	475	622	100
Burnside/Bryndwr	460	187	406	22	387	841	45	257	558	30	27	59	3	858	1865	100
Hoon Hay	421	104	248	18	215	510	38	230	546	40	23	55	4	572	1358	100
Hornby	498	175	351	23	355	713	46	220	441	28	24	49	3	774	1553	100
Marshlands	1135	156	137	21	318	280	44	215	189	30	35	31	5	724	638	100
New Avonhead	230	1	2	17	1	6	41	1	4	30	0	2	13	3	15	100
New Brighton	1942	398	205	22	819	422	44	570	293	31	59	30	3	1845	950	100
Parklands	312	55	175	22	111	357	44	78	250	31	8	25	3	252	806	100
Racecourse	247	13	54	18	31	127	42	23	92	30	7	29	10	75	303	100
Redwood	752	120	160	22	251	334	46	147	195	27	26	35	5	544	724	100
Sockburn	264	195	738	22	399	1512	45	246	932	28	44	165	5	884	3347	100
Wigram	786	150	191	22	308	391	45	191	243	28	33	42	5	682	867	100
Sub-total	11741	2564	218	22	5230	445	44	3498	298	30	471	40	4	11763	1002	100
Total - Total Study Area	17757	6132	345	22	12591	709	45	8214	463	29	1206	68	4	28143	1585	100

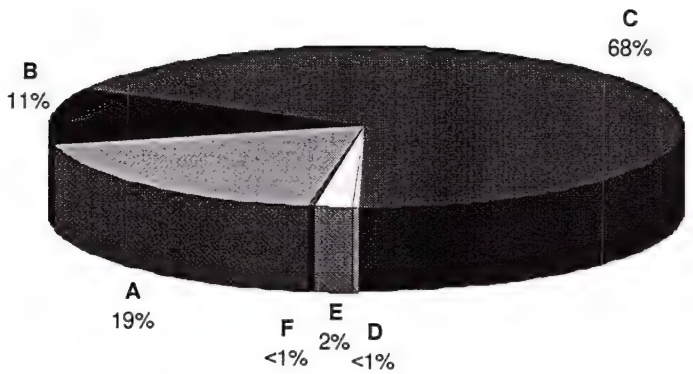
Table 4.16 CO_2 emissions produced at different times of a typical winter's day by motor vehicles across various suburb areas of Christchurch.

Suburb Area	Area (ha)	6am-10am			10am-4pm			4pm-10pm			10pm-6am			Daily Total		
		kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total
Inner Suburb Study Area																
Beckenham/Sydenham	555	35302	63608	22	73156	131812	45	47018	84717	29	7899	14233	5	163375	294370	100
Fendalton	745	29117	39084	22	59364	79684	44	39118	52507	29	6775	9094	5	134375	180369	100
Inner City	635	65222	102711	22	134953	212525	46	81863	128919	28	13910	21905	5	295948	466060	100
Linwood	754	42258	56046	22	86078	114161	44	57640	76446	29	9851	13064	5	195827	259717	100
Opawa/Woolston	798	35717	44758	22	74118	92880	45	47643	59704	29	8012	10040	5	165490	207381	100
Riccarton	349	28066	80420	22	58055	166347	46	34793	99693	27	6183	17717	5	127098	364176	100
Shirley	572	17051	29809	21	35311	61732	44	24132	42189	30	3701	6470	5	80194	140200	100
Spreydon/Addington	745	35781	48028	22	74229	99637	45	47647	63956	29	8009	10751	5	165667	222372	100
St Albans	864	38107	44105	22	78427	90772	44	51692	59829	29	8809	10195	5	177034	204901	100
Sub-total - Inner Suburb Study Area	6016	326621	54292	22	673691	111983	45	431547	71733	29	73149	12159	5	1505008	250168	100
Outer Suburbs																
Addington Industrial	230	10979	47736	22	23000	99999	46	13452	58489	27	2388	10383	5	49819	216606	100
Airport	2088	20038	9597	22	38757	18562	43	26014	12459	29	4534	2172	5	89343	42789	100
Avonhead	727	44723	61517	22	91201	125449	45	59016	81178	29	9837	13531	5	204777	281674	100
Bishopdale	887	14582	16440	22	28471	32098	43	19206	21653	29	3277	3695	5	65536	73885	100
Bromley	764	15115	19784	22	30077	39368	44	20294	26563	29	3327	4355	5	68813	90070	100
Burnside/Bryndwr	460	17095	37163	21	35403	76963	44	23501	51089	29	3946	8579	5	79945	173793	100
Hoon Hay	421	15102	35871	21	31048	73749	44	21020	49930	30	3367	7996	5	70537	167546	100
Hornby	498	15994	32117	22	32488	65238	45	20102	40365	28	3496	7019	5	72080	144739	100
Marshlands	1135	22516	19838	21	46056	40578	44	31090	27392	30	5079	4475	5	104741	92283	100
New Avonhead	230	53	228	17	126	547	41	91	396	30	39	170	13	308	1341	100
New Brighton	1942	36425	18757	21	74950	38594	44	52125	26841	30	8525	4390	5	172026	88582	100
Parklands	312	4994	16008	21	10180	32627	43	7144	22898	30	1108	3551	5	23427	75085	100
Racecourse	247	2459	9956	18	5749	23274	42	4152	16808	30	1310	5302	10	13669	55340	100
Redwood	752	10979	14600	22	23000	30585	46	13452	17889	27	2388	3176	5	49819	66249	100
Sockburn	264	17830	67539	22	36526	138358	45	22526	85326	28	3986	15099	5	80869	306322	100
Wigram	786	21685	27589	22	44507	56625	45	27688	35227	28	4754	6049	5	98635	125489	100
Sub-total	11741	270569	23045	22	551538	46975	44	360875	30736	29	61363	5226	5	1244346	105983	100
Total - Total Study Area	17757	597191	33631	22	1225230	69000	45	792422	44626	29	134511	7575	5	2749353	154832	100

5. Industrial Emissions

5.1. Christchurch Industry - Background

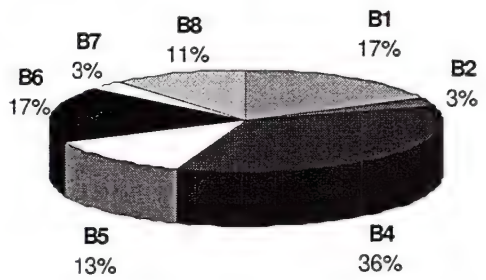
Across the total study area of Christchurch it is estimated that there are approximately 565 industrial and commercial premises that emit various quantities of PM_{10}, CO, NO_x, SO_x, VOC and CO_2 into the air on a typical winter's day. Approximately 70% of Christchurch industries are considered commercial in nature (Figure 5.1). These industries primarily emit pollutants from the combustion of solid fuels for heating or as part of their operations. Manufacturing makes up approximately 11% of Christchurch industries while nearly 20% of industries use surface coatings or thinners (paint, varnish, lacquer or paint primer). Community services make up about 2% while wholesale and trade, and services allied to transport represent less than 1% of industries combined.



A = Surface coatings and thinners **B** = Manufacturing **C** =Commercial - combustion
D = Services allied to transport **E** = Community Services **F** =Wholesale and trade

Figure 5.1 Christchurch industry breakdown

Manufacturing industries within Christchurch can be further divided into eight categories (Figure 5.2). 36% of manufacturing industries produce chemicals, rubber and plastic products while 13% produce non-metallic mineral products (i.e glass, bricks and clay products, cement, lime). 17% of manufacturing industries produce food and beverage and a further 17% manufacture basic metal (i.e foundries). Wood processing and wood product manufacturers make up 11% while producers of textiles, clothing and leather goods, as well as fabricated metal manufacturers represent 3% each.



B1	Food and beverage
B2	Textile/clothing/leather
B3	Paper and paper products, printing and publishing
B4	Chemicals, rubber and plastic products
B5	Non-metallic mineral products
B6	Basic metal
B7	Fabricated metal
B8	Wood and wood products

Figure 5.2 Christchurch manufacturing industry breakdown.

Like manufacturing, community services can also be divided into four categories (Figure 5.3). Educational and medical facilities around Christchurch represent 50% of the community service industries, while recreational and cultural services represent 10%. Sanitary services (including refuse burning and pathological waste) represent 40% of community services in Christchurch while laundries and cleaning facilities represent less than 1%.

E1	Educational and medical facilities
E2	Sanitary and similar services
E3	Recreational and cultural services
E4	Laundries, cleaning

Figure 5.3 Christchurch community service breakdown.

For the purpose of this inventory, emissions have been assessed on the size of industry and not industry type primarily because the scale of process, the fuel consumption, the boiler size and control technology used can directly influence pollutant emissions to the air. As a result, three categories of industry have been adopted (Part A, Part B and Part C). The classification of Part A, B and C industries within Christchurch were based on definitions from the Clean Air Act 1972 (Appendix IV).

Based on this classification scheme, 3.5% of the 565 industries across the total study area of Christchurch are considered large scale, 14% medium sized, and over 80% are considered small commercial and industrial operations (Table 5.1).

Within the inner suburb study area, 2% of the industries are considered larger scale Part A's, 13% are considered Part B industries and 85% are smaller Part C industries (Table 5.1). Overall, 55% of industries within Christchurch are located within the inner suburb study area. Furthermore, 28% of industries are located within the inner city.

Table 5.1 Number and type of industry within various study areas of Christchurch.

Suburb Area	Industry Type and Number			
	Total Number	A	B	C
Inner Suburb Study Area				
Beckenham/Sydenham	6	0	0	6
Fendalton	13	0	0	13
Inner City	156	3	20	133
Linwood	20	0	1	19
Opawa/Woolston	47	3	11	33
Riccarton	9	0	2	7
Shirley	11	0	1	10
Spreydon/Addington	28	0	3	25
St Albans	21	0	2	19
Sub-total - Inner Suburb Study Area	311	6	40	265
Outer Suburbs				
Addington Industrial	7	1	2	4
Airport	9	4	2	3
Avonhead	15	0	2	13
Bishopdale	22	0	2	20
Bromley	47	2	7	37
Burnside/Bryndwr	2	0	0	2
Hoon Hay	10	0	1	9
Hornby	32	3	8	21
Marshlands	8	0	0	8
New Avonhead	3	0	0	3
New Brighton	29	0	3	26
Parklands	6	2	0	4
Racecourse	0	0	0	0
Redwood	17	0	0	17
Sockburn	13	0	4	9
Wigram	35	2	7	26
Sub-total	254	14	38	202
Total - Total Study Area	565	20	78	467

5.2. Industrial Emission Factors, Calculation Techniques and Assumptions

Emissions from industrial sources were considered separately under combustion and process emissions. For the calculations, data were required on the amount / nature of the fuel consumed and the amount / nature of any raw materials used and products produced for each individual industry. Much of the information was gained from existing Council resource consent files but was supplemented with information gathered from a survey of larger scale industries (designated Part A and Part B) (see Appendix II for survey questionnaire).

5.2.1 Combustion Emissions

For the calculation of combustion emissions, emission factors for various boiler sizes were developed from a literature survey of 'utility' (power generating) and 'commercial' (heat generating) boilers. (United States Environmental Protection Agency (USEPA) (1994), Economopoulos (1993), International Panel on Climate Change (1995), and Air Pollution Engineering Manual (1992)). Some fuels had more emissions factors available for the different boiler sizes and presented a range of factors depending on the control technology used. From these numbers and descriptions, emissions factors were selected that best represent 'worst', 'best' and 'typical' operation for boilers in New Zealand.

Because of the difficulty encountered when trying to obtain information on the actual control technology used for each individual industry, typical figures were adopted for this inventory as they assume average operating conditions (Table 5.2). However, it should be noted that processes using older technology or, conversely, state of the art abatement equipment may have emissions rates significantly higher or lower than the numbers shown below.

Table 5.2 Boiler emission factors per unit of fuel burnt.

Fuel	Boiler Size	Typical Fuel Use 10^3m^3/yr or T/yr	PM_{10} kg/U	CO kg/U	NO_x kg/U	SO_x kg/U	VOC kg/U	CO_2 kg/U
Natural Gas	5 MW	4380	0.086	0.560	1.300	0.010	0.100	2010
10^3m^3	50 MW	43800	0.096	0.640	4.550	0.010	0.092	2010
LPG	5 MW	3430	0.060	0.710	2.600	0.007	0.120	2885
Tonne	50 MW	34300	0.060	0.710	2.600	0.007	0.120	2885
Oil	40 kW	31	0.280	0.640	2.800	4.000	0.180	3010
Tonne	10 MW	7690	0.280	0.640	2.800	4.000	0.180	3010
Coal	40 kW	50	5.000	2.300	8.200	17.500	0.060	2355
Tonne	10 MW	12600	5.000	2.500	9.000	17.500	0.060	2355
Wood	40 kW	126	1.300	2.000	0.330	0.037	0.150	1100
Tonne	10 MW	31500	1.300	13.000	1.150	0.037	0.150	1100

The factors in Table 5.2 reflect the differences in emissions from various industrial boilers depending on the fuel used. Take PM_{10} and NO_x emissions from the burning of coal on a 10 MW boiler for example. Coal burning can produce as much as 18 times more PM_{10} and three times more NO_x than oil burning, and approximately four times the quantity of PM_{10}, eight times more NO_x and as much as 470 times more SO_x than wood burning.

Overall, NO_x and CO emissions (but to a lesser extent) are influenced by boiler size whereas SO_x VOC, CO_2 and PM_{10} emissions are effectively fuel dependent and do not vary with the boiler size.

Using the typical emissions rates for each of the key contaminants (Table 5.2), and the actual fuel consumption information obtained from survey questionnaires and/or CRC resource consent records, the daily emissions of each contaminant from combustion processes for each industrial source were then calculated for a typical winter's day using the following formula:

*Combustion Emissions (kg/day) = Actual Fuel Consumption (U/day) * Unit Emissions Rate (kg/U)*

where the typical emissions rate depends on the size of the process and *U* is the unit of production (t or m^3 etc.).

So, to calculate CO emissions from the burning of 5 tonne of coal per day on a 40 kW boiler, the equation would look like:

*CO Emissions (kg/day) = 5 t/day * 2.3 kg/t = 11.5 kg/day*

5.2.2 Process Emissions

For the calculation of process emissions where applicable (as not all industries produce process emissions), emissions factors were developed for each industry type from USEPA and Economopoulos. These factors are based on the amount of raw materials used or the amount of product produced and were scaled using the actual information from consent records and/or survey data to give process emissions totals for the different contaminants. Again, as in the case of the combustion emissions, the process emissions factors assume typical operation as follows:

*Process Emissions (kg/day) = Actual Product Produced or Raw Materials Consumed (U/day) * Unit Emissions Rate (kg/U)*

where the U is the unit of production (t or m^3 etc.) and the unit emissions rate depends on the nature of the process.

For example, for an industry producing 100 tonnes of resins and adhesives per day, the equation for VOC emissions would look like:

*VOC Emissions (kg/day) = 100 t/day * 3.0 kg/t = 300 kg/day*

Please note that resin / adhesive manufacture results in VOC only process emissions. Other industry processes emit other contaminants (see Appendix V).

Following calculation of both combustion and process emissions, the total industrial emissions for all industry within a suburb were then aggregated to produce daily kilogram totals. To produce a "normalised" weight per area value (e.g. grams per hectare), emissions were then divided by the number of hectares within each suburb area (1 hectare = $10000m^2$). This normalisation was done to allow fair comparison between differently-sized study areas.

To establish the fuel quantities used, the product produced or the raw materials consumed on a typical winter's day, annual figures were divided into seasonal quantities based on variation in industry operation. The winter consumption for each industry was then divided by 182.5 days. This gave a daily quantity.

5.2.3 Assumptions

The following assumptions were made for the calculation of industrial emissions.

1. The amount of energy released per unit fuel (calorific value or CV) for the different fuels:

   Natural gas 36 MJ/m3
   LPG 46 MJ/kg
   Oil 41 MJ/kg
   Coal 25 MJ/kg
   Wood 10 MJ/kg

   This information is used to calculate the typical annual fuel consumption figures given in Table 5.2

2. typical coal = 1.0 wt% sulphur (range 0.4 to 2.0) (The typical sulphur content directly reflects the SO_x emission factors.)

3. ash content of coal = 4.0 wt% (range 3.0 to 5.0) (This reflects the amount of PM_{10} emitted from coal burning.)

4. density of LPG = 0.5 kg/litre (conversion factors if different units are specified)

5. density of oil = 0.845 kg/litre (conversion factors if different units are specified)

6. "oil" refers to automotive diesel, marine diesel, and blended heating oil as the physical properties of each are almost identical. (The Ministry of Commerce Energy Data File considers these fuels together but under the classification 'diesel'.)

7. Hours of operation (unless specified). Used for the calculation of daily fuel, product and raw material quantities, and resultant pollutant emissions and times:

   Part A industries 24 hours a day, 7 days a week
   Part B industries 12 hours a day (between 6am and 6pm), 6 days a week
   Part C industries 8 hours a day (between 8am and 5pm), 5 days a week

8. Boiler size emissions factor category:

   Part A industries 10 MW - 50 MW
   Part B industries 10 MW - 50 MW
   Part C industries 40 kW - 5 MW

5.3. Industrial Emissions on a Typical Winter's Day by Industry Type

Emissions to the air from various industry on a typical winter's day for the total study area, and the inner suburb study area, are presented in Figure 5.4, Figure 5.5, Table 5.3 and Table 5.4.

Across the total study area, Part A industries are the main emitters of PM_{10} (44%) and VOC (47%), while Part B industries emit larger quantities of CO (50%), NO_x (40%) and SO_x (39%). Part C industries emit nearly half the CO_2 (46%) (Figure 5.4 and Table 5.3).

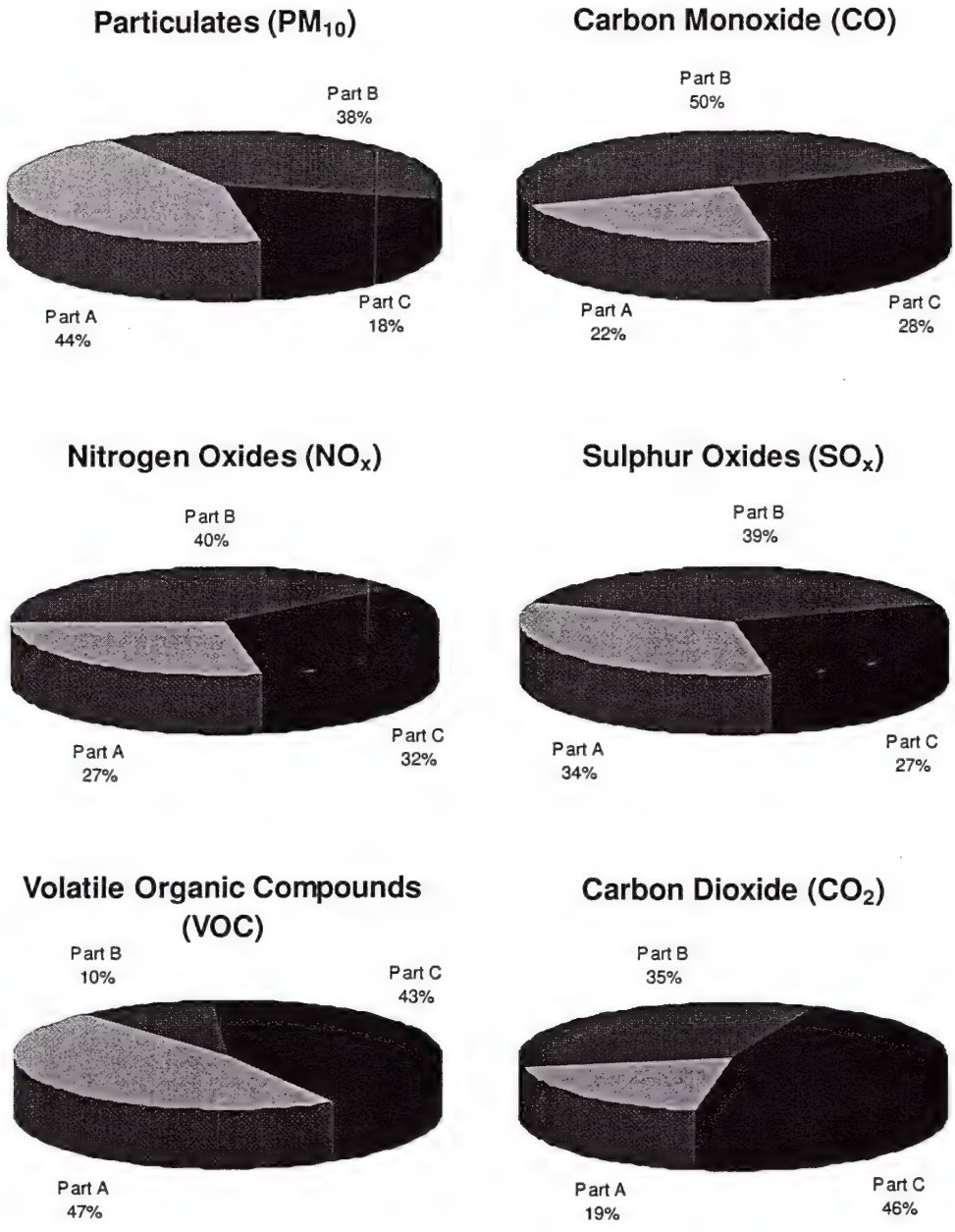


Figure 5.4 Emissions by industry type for the total study area.

Within the inner suburb study area, Part A industries are the main emitters of PM_{10} (46%), while Part B industries emit larger quantities of CO (37%), NO_x (37%) and SO_x (39%). Part C industries emit approximately 80% of VOC and over half the CO_2 (51%) (Figure 5.5 and Table 5.4).

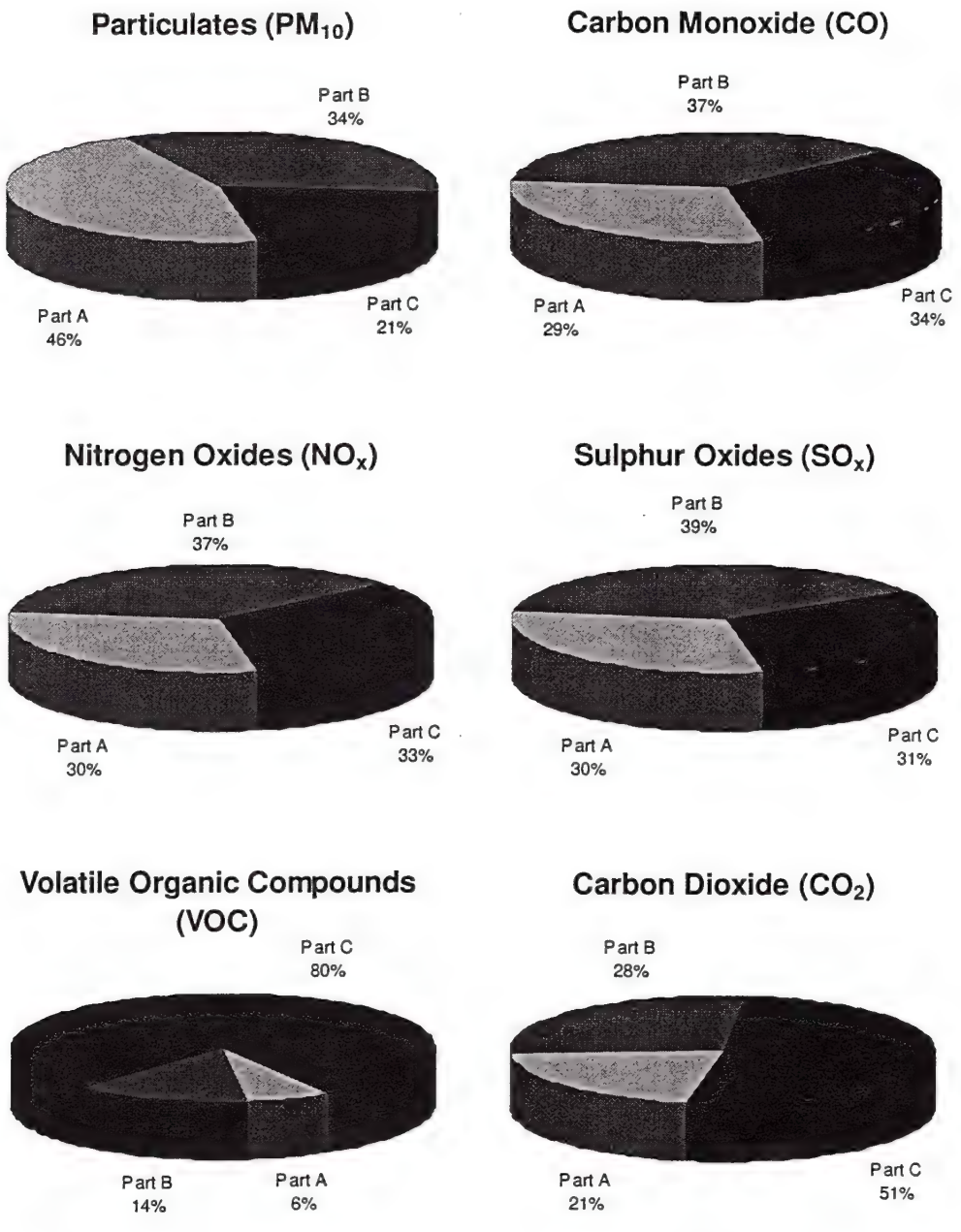


Figure 5.5 Emissions by industry type for the inner suburb study area.

The estimated quantities released (per day and per hectare) from each industry type differs between the total study area and the inner suburb study (Table 5.3 and Table 5.4). On average, Part A industries within the inner suburb area produce approximately half of the kilogram per day figure for all pollutants except VOC. The total study area produces approximately 20 times more per day. However on a per hectare basis, the inner suburb study area produces 1.6 times more PM_{10} per hectare than the total study area, 1.7 times the CO_2, 1.8 times the CO and NO_x and 1.3 times the SO_x. The total study area however, produces 7 times more VOC than the inner suburb study area.

Part B and C industries also display this pattern. On a kilogram per day basis, Part B industries within the inner suburb area emit 40%-50% of the kg/day figure, yet on a per hectare basis they produce 1.3 times more PM_{10} and CO_2 than the total study area, 1.5 times the NO_x and SO_x, 1.2 times the VOC, and equal quantities of CO.

Part C industries within the inner suburb area produce 1.8 times more PM_{10} per hectare than the total study area, 1.7 times the NO_x, SO_x and CO_2, and 1.9 times the VOC and CO. On a kilogram per day basis, Part C industries produce approximately half to a third the quantities of the total study area.

When examining Part A, B and C industries more closely, 18 of the 20 Part A industries (90%) across Christchurch emit 20% of PM_{10}, 22% of CO, 27% of NO_x, 24% of SO_x, 1% of VOC and 19% of CO_2 emissions from the combustion of solid fuels. For Part B industries, 63 of the 78 premises (80%) contribute to 38% of PM_{10}, 50% of CO, 40% of NO_x, 39% of SO_x, 1% of VOC and 35% of CO_2 emissions from the combustion of solid fuels. Nearly 98% of Part C industries (457) across Christchurch emit 18% of PM_{10} emissions, 28% of CO, 32% of NO_x, 27% of SO_x, 2% of VOC and 46% CO_2 emissions from the combustion of solid fuels (Table 5.3).

Within the inner suburb study area, 5 of the 6 Part A industries (83%) emit 25% of PM_{10}, 29% of CO, 30% of NO_x and SO_x, 1% of VOC and 21% of CO_2 emissions from the combustion of solid fuels. For Part B industries, 34 of the 40 premises (85%) contribute to 34% of PM_{10}, 37% of CO and NO_x, 39% of SO_x, 1% of VOC and 28% of CO_2 emissions from the combustion of solid fuels. Approximately 99% of Part C industries (262) within the inner suburb study area emit 21% of PM_{10} emissions, 34% of CO, 33% of NO_x, 31% of SO_x, 3% of VOC and 51% CO_2 emissions from the combustion of solid fuels (Table 5.4).

Emissions from other processes are somewhat different. 40% of Part A industries (8) across Christchurch emit 24% of the total industrial PM_{10} emissions. Furthermore, 20% of Part A (4), 27% of Part B (21) and 22% of Part C industries (103) emit VOC from other processes (46%, 9% and 41% of the industrial total respectively). 10% of Part A industries (2) also emit NO_x (less than 1% of the total) and 5% emit SO_x (9% of the total).

50% of Part A industries (3) within the inner suburb study area emit 21% of the total industrial PM_{10} emissions. 17% of Part A (4), 33% of Part B (25) and 18% of Part C industries (84) emit VOC from other processes (6%, 12% and 77% of the industrial total respectively). 17% of Part A industries (4) also emit NO_x (less that 1% of the total).

These results indicate that the nature and size of the industry can influence process emissions. Within Christchurch, PM_{10} emissions from other processes are commonly released during the manufacture of concrete, bitumen, chemicals, fertilisers, food and the processing of animal by-products. VOC emissions are primarily released with the application of paints, varnishes, lacquers and thinners, as well as with the manufacture of chemicals and fertilisers (which also release SO_x).

Take VOC emissions for example. As previously mentioned, across Christchurch, Part A industries produce 46% of VOC emissions, Part B premises produce 9% and Part C's 41%. Within the inner suburb study area, 77% of VOC emissions stem from Part C industries, 12% from Part B premises and 1% from Part A industries. Approximately 107 industries (19% - Figure 5.1) within Christchurch involve the application of surface coatings and thinners (the main source of VOC emissions from other processes), approximately 80% of which are located within the inner suburb study area. The high number of industries that use surface coatings and thinners is reflected in the high percentage of process VOC emissions, especially within the inner suburb study area.

Individual suburb results can be found in Appendix III

Table 5.3 Emissions by industry type for the total study area.

	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Part A																		
Combustion	203	11	20	107	6	22	391	22	27	738	42	24	4	0	1	131522	131522	19
Other Processes	244	14	24	0	0	0	7	0	0	289	16	9	371	21	46	0	0	0
Sub-total	447	25	44	107	6	22	399	22	27	1027	58	34	375	21	47	131522	7407	19
Part B																		
Combustion	383	22	38	238	13	50	585	33	40	1192	67	39	12	1	1	238149	13411	35
Other Processes	2	0	0	0	0	0	0	0	0	0	0	0	68	4	9	0	0	0
Sub-total	385	22	38	238	13	50	585	33	40	1192	67	39	80	5	10	238149	13411	35
Part C																		
Combustion	185	10	18	132	7	28	468	26	32	835	47	27	16	1	2	319213	17977	46
Other Processes	1	0	0	0	0	0	0	0	0	0	0	0	326	18	41	0	0	0
Sub-total	186	10	18	132	7	28	468	26	32	835	47	27	342	19	43	319213	17977	46
Total																		
Combustion	771	43	76	478	27	100	1445	81	100	2766	156	91	32	2	4	688883	162910	100
Other Processes	247	14	24	0	0	0	7	0	0	289	16	9	766	43	96	0	0	0
Total	1018	57	100	478	27	100	1452	82	100	3055	172	100	798	45	100	688883	38795	100

Table 5.4 Emissions by industry type for the inner suburb study area.

	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Part A																		
Combustion	128	21	25	67	11	29	243	40	30	463	77	30	2	0	1	77272	12844	21
Other Processes	105	17	21	0	0	0	1	0	0	0	0	0	16	3	6	0	0	0
Sub-total	233	39	46	67	11	29	244	41	30	463	77	30	18	3	6	77272	12844	21
Part B																		
Combustion	172	29	34	83	14	37	298	50	37	617	103	39	3	1	1	104572	17382	28
Other Processes	0	0	0	0	0	0	0	0	0	0	0	0	34	6	12	0	0	0
Sub-total	172	29	34	83	14	37	298	50	37	617	103	39	38	6	14	104572	17382	28
Part C																		
Combustion	107	18	21	77	13	34	273	45	33	484	80	31	10	2	3	189254	31458	51
Other Processes	0	0	0	0	0	0	0	0	0	0	0	0	213	35	77	0	0	0
Sub-total	107	18	21	77	13	34	273	45	33	484	80	31	223	37	80	189254	31458	51
Total																		
Combustion	406	68	79	228	38	100	815	135	100	1564	260	100	15	3	5	371098	61684	100
Other Processes	105	17	21	0	0	0	1	0	0	0	0	0	263	44	95	0	0	0
Total	512	85	100	228	38	100	815	136	100	1564	260	100	279	46	100	371098	61684	100

5.4. Industrial Emissions on a Typical Winter's Day - Total

Industrial emissions to the air on a typical winter's day for various study areas of Christchurch are presented in Table 5.5 over.

The total study area is estimated to produce approximately 1018 kilograms of PM_{10} per day or 57 grams per hectare per day whereas the inner suburb study area is estimated to produce half the total PM_{10} emissions (512 kg/day) (Table 5.5). On a grams per hectare basis, the PM_{10} emissions from industry within the inner suburb study area are 1.5 times greater than the total study area (85 g/ha/day compared to 57 g/ha/day).

A similar pattern emerges when examining the CO, NO_x, SO_x, VOC and CO_2 emissions from industry (Table 5.5). The inner suburb study area is estimated to produce nearly 50% of the total CO emissions, ~55% of the total NO_x and CO_2 emissions, 51% of the total SO_x emissions and 35% of the VOC emissions. On a grams per hectare basis, the inner suburb study area produces 1.4 times more CO than the total study area, 1.6 times the NO_x and CO_2 and 1.5 times the SO_x. VOC emissions per hectare are the same in both the total study area and the inner suburb study area.

On an individual suburb basis (Table 5.5), industrial emissions vary considerably from suburb to suburb. Suburb areas with few industries (such as Burnside/Bryndwr and New Avonhead) exhibit lower pollutant emissions from industrial sources per day whereas suburbs with a greater number of industries (such as the Inner City) displayed higher pollutant concentrations. The suburb of Racecourse, having no industries, has no emissions.

Table 5.5 Typical winter's day emissions from industry for various study areas of Christchurch.

Suburb Area	Area (ha)	PM_{10} kg	PM_{10} % Total	PM_{10} g/ha	CO kg	CO % Total	CO g/ha	NO_x kg	NO_x % Total	NO_x g/ha	SO_x kg	SO_x % Total	SO_x g/ha	VOC kg	VOC % Total	VOC g/ha	CO_2 kg	CO_2 % Total	CO_2 g/ha
Inner Suburb Study Area																			
Beckenham/Sydenham	555	2	0	4	1	0	3	5	0	10	10	0	18	5	1	10	2823	0	5090
Fendalton	745	13	1	17	7	1	9	22	2	29	45	1	60	0	0	0	8516	1	11431
Inner City	635	296	29	466	155	33	245	558	38	880	1079	35	1701	142	18	223	220191	32	346971
Linwood	754	5	0	6	4	1	6	11	1	14	18	1	25	21	3	27	8468	1	11233
Opawa/Woolston	798	162	16	203	40	8	50	150	10	187	276	9	346	68	9	85	94055	14	117818
Riccarton	349	6	1	16	3	1	10	13	1	37	24	1	70	2	0	6	7709	1	22085
Shirley	572	10	1	18	5	1	9	17	1	30	36	1	63	0	0	0	6130	1	10711
Spreydon/Addington	745	11	1	14	6	1	8	22	2	30	43	1	58	37	5	50	12139	2	16303
St Albans	864	7	1	9	5	1	6	17	1	20	32	1	37	3	0	4	11066	2	12813
Sub-total - Inner Suburb Study Area	6016	512	50	85	228	48	38	815	56	136	1564	51	260	279	35	46	371098	54	61683
Outer Suburbs																			
Addington Industrial	229	1	0	4	2	0	7	5	0	23	5	0	21	6	1	24	6023	1	26249
Airport	2088	42	4	20	2	0	1	10	1	5	14	0	7	5	1	2	11796	2	5651
Avonhead	727	135	13	186	118	25	163	155	11	213	302	10	415	7	1	10	88225	13	121417
Bishopdale	887	12	1	13	7	2	8	28	2	31	49	2	55	3	0	4	17712	3	19979
Bromley	764	7	1	10	8	2	10	28	2	37	45	1	59	54	7	70	26070	4	34121
Burnside/Bryndwr	460	1	0	2	0	0	1	2	0	3	3	0	7	0	0	0	753	0	1639
Hoon Hay	421	67	7	159	31	7	74	111	8	263	236	8	560	6	1	14	33159	5	78689
Hornby	498	141	14	282	29	6	57	105	7	211	484	16	972	351	44	705	44241	6	88827
Marshlands	1135	3	0	2	2	0	2	7	0	6	12	0	11	3	0	2	4217	1	3715
New Avonhead	230	1	0	4	1	0	3	3	0	11	5	0	20	0	0	0	2027	0	8811
New Brighton	1942	8	1	4	7	1	3	24	2	12	41	1	21	34	4	18	19040	3	9806
Parklands	312	41	4	130	17	4	55	68	5	217	119	4	382	0	0	2	17389	3	55698
Racecourse	247	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Redwood	752	9	1	12	6	1	7	19	1	25	36	1	48	8	1	11	10593	2	14095
Sockburn	264	20	2	75	10	2	37	32	2	122	65	2	248	9	1	35	13152	2	49784
Wigram	786	20	2	25	12	2	15	41	3	52	75	2	95	33	4	42	23388	3	29770
Sub-total	11741	506	50	43	250	52	21	637	44	54	1491	49	127	519	65	44	317786	46	27066
Total - Total Study Area	17757	1018	100	57	478	100	27	1452	100	82	3055	100	172	798	100	45	688883	100	38794

Table 5.6 Typical winter's day emissions from industry in descending order of PM_{10} for the 25 suburb areas of Christchurch.

	Industry Type and Number				Pollutant (g/day)					
Suburb Area	Total	A	B	C	PM_{10}	CO	NO_x	SO_x	VOC	CO_2
Inner City	156	3	20	133	296025	155402	558227	1079319	141783	220190926
Opawa/Woolston	47	3	11	33	162108	40150	149519	276003	68173	94054651
Hornby	32	3	8	21	140568	28613	105193	484014	351008	44241022
Avonhead	15	0	2	13	135498	118157	155117	301782	7176	88225003
Hoon Hay	10	0	1	9	67077	31063	110957	235996	6077	33158593
Airport	9	4	2	3	42228	2378	10270	13693	4548	11796264
Parklands	6	2	0	4	40529	17036	67879	119223	480	17389115
Sockburn	13	0	4	9	19836	9738	32116	65467	9321	13152494
Wigram	35	2	7	26	19536	11766	40726	74756	32767	23388352
Fendalton	13	0	0	13	12512	6592	21791	44752	330	8515999
Bishopdale	22	0	2	20	11503	7283	27782	48822	3416	17712126
Spreydon/Addington	28	0	3	25	10664	6311	22464	43355	36951	12139465
Shirley	11	0	1	10	10147	5148	17197	35794	218	6130286
Redwood	17	0	0	17	8933	5630	18692	35702	8308	10593440
New Brighton	29	0	3	26	7929	6590	23914	41109	34226	19039968
Bromley	47	2	7	37	7488	7630	27951	44983	53672	26069585
St Albans	21	0	2	19	7443	5022	17336	31875	3144	11065845
Riccarton	9	0	2	7	5528	3384	12918	24317	1957	7708501
Linwood	20	0	1	19	4634	4197	10665	18471	20647	8468478
Marshlands	8	0	0	8	2753	1748	6720	12480	2799	4217200
Beckenham/Sydenham	6	0	0	6	2461	1406	5290	10231	5324	2823428
Addington Industrial	7	1	2	4	873	1565	5199	4888	5523	6022925
New Avonhead	3	0	0	3	858	663	2635	4587	103	2026622
Burnside/Bryndwr	2	0	0	2	747	410	1527	3004	32	753180
Racecourse	0	0	0	0	0	0	0	0	0	0
Average	23	1	3	19	40715	19115	58083	122185	31919	27555339
Median	47	3	11	33	162108	40150	149519	276003	68173	94054651

5.5. Industrial Emissions by Time of Day

Across the total study area, ~40% of PM_{10}, CO, NO_x and SO_x, and ~45% of VOC and CO_2 are released between the hours of 10am and 4pm on a typical winter's day. The remaining emissions are evenly spread between the three other time periods (Figure 5.6 and Table 5.7).

Within the inner suburb study area, 34% to 39% of PM_{10}, CO, NO_x and SO_x, 60% of VOC and 46% of CO_2 emissions are released between the hours of 10am and 4pm on a typical winter's day (Figure 5.7 and Table 5.8). With the exception of VOC, the remaining emissions are evenly spread between the three other time periods. For VOC, 25% of the emissions are released between 6am and 10am while 14% are emitted from 4pm to 10pm. 1% of VOC emissions are released from 10pm and 6am.

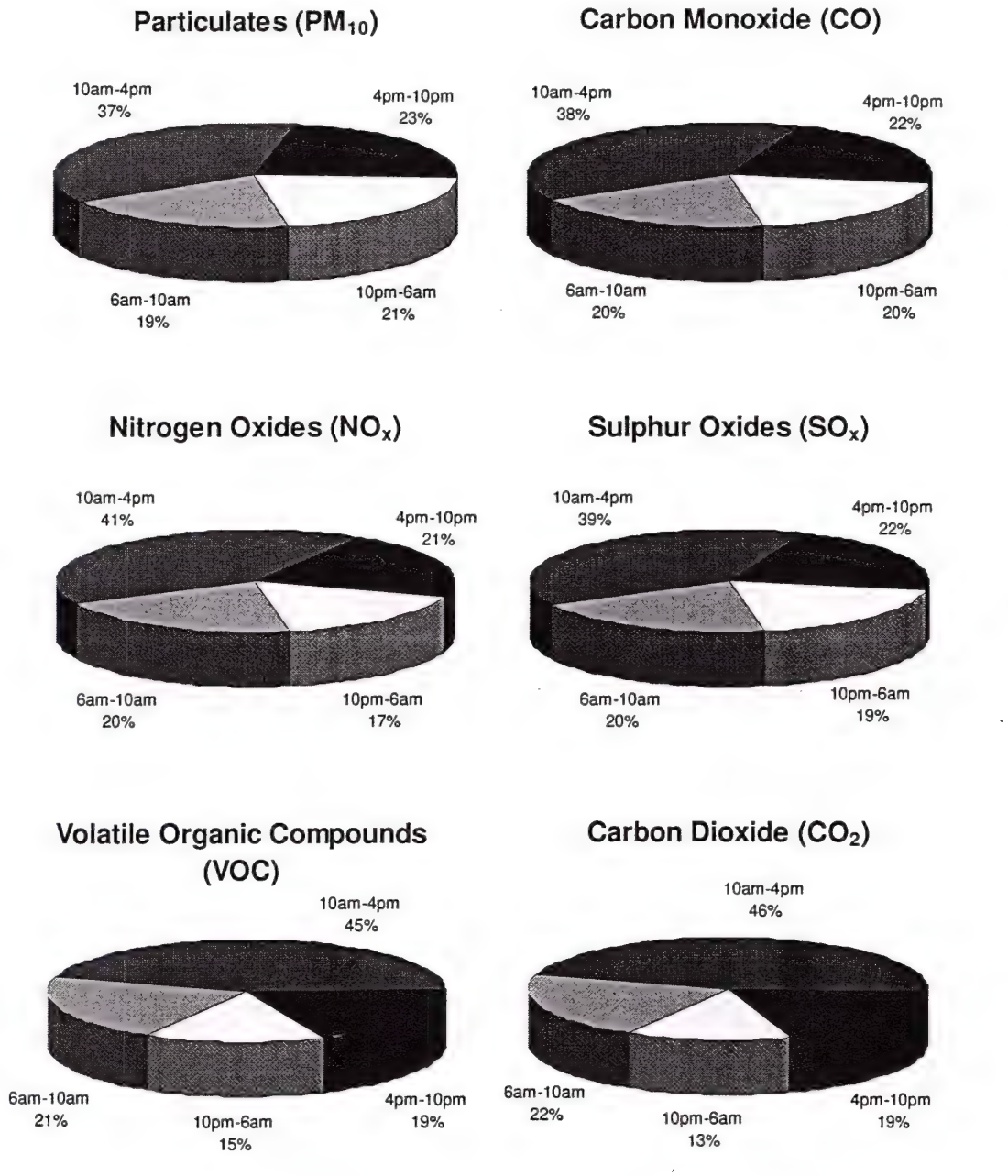


Figure 5.6 Breakdown of industrial emissions for different times of a typical winter's day for the total study area

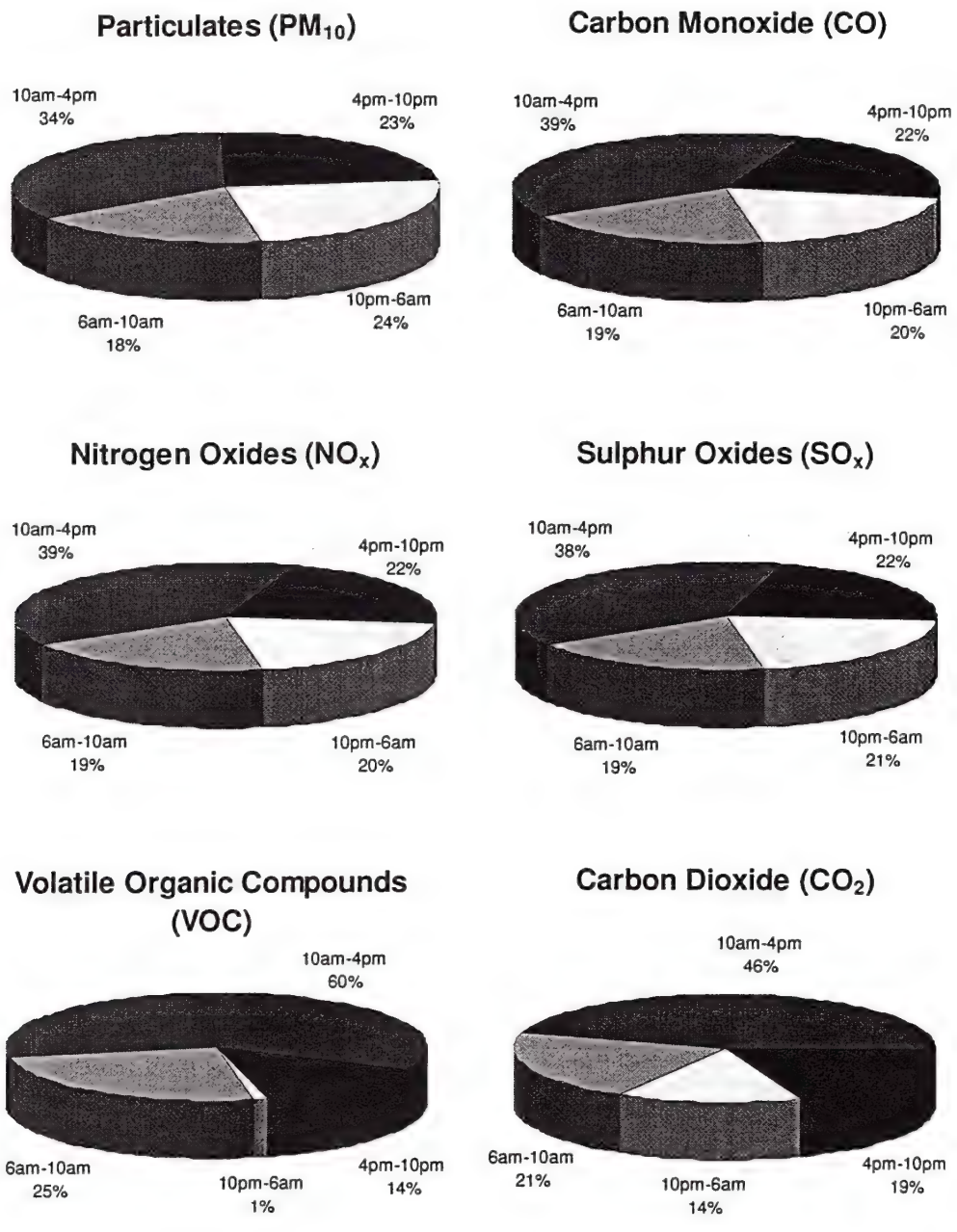


Figure 5.7 Breakdown of industrial emissions for different times of a typical winter's day for the inner suburb study area

On an individual suburb basis, PM_{10}, CO, NO_x, SO_x, VOC and CO_2 emissions tended to peak between the hours of 4pm and 10pm. In the suburbs where the peak does not occur between 4pm and 10pm, it tends to be highest between 10pm and 6am (Table 5.9 - Table 5.14).

In ~70% of the suburbs, the next highest period of PM_{10}, CO, NO_x, SO_x, and CO_2 emissions occurred between 6am and 10am. For VOC, ~85% of the suburbs also displayed a secondary peak between 6am and 10am. Low PM_{10}, CO, and SO_x emissions were displayed between 10pm and 6am in ~75% of the suburbs. Over 80% of the suburbs displayed low NO_x, CO_2, and VOC between 10pm and 6am.

Table 5.7 Estimated industry emissions for various times of a typical winter's day across the total study area.

	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
6am-10am	198	11	19	95	5	20	298	17	20	609	34	20	170	10	21	148132	8342	22
10am-4pm	374	21	37	185	10	39	597	34	41	1188	67	39	358	20	45	314953	17736	46
4pm-10pm	230	13	23	105	6	22	311	17	21	673	38	22	152	9	19	133825	7536	19
10pm-6am	217	12	21	93	5	20	247	14	17	584	33	19	118	7	15	91974	5179	13
Total	1018	57	100	478	27	100	1452	82	100	3055	172	100	798	45	100	688883	38794	100

Table 5.8 Estimated industry emissions for various times of a typical winter's day across the inner suburb study area.

	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
6am-10am	93	16	18	44	7	19	157	26	19	297	49	19	69	11	25	78034	12971	21
10am-4pm	175	29	34	89	15	39	318	53	39	592	98	38	168	28	60	169771	28219	46
4pm-10pm	119	20	23	49	8	22	178	30	22	348	58	22	39	6	14	71037	11808	19
10pm-6am	124	21	24	45	7	20	163	27	20	326	54	21	3	1	1	52255	8686	14
Total	512	85	100	228	38	100	815	136	100	1564	260	100	279	46	100	371098	61683	100

Table 5.9 PM_{10} emissions produced at different times of a typical winter's day by industry across various suburb areas of Christchurch.

Suburb Area	Area (ha)	6am-10am			10am-4pm			4pm-10pm			10pm-6am			Daily Total		
		kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total
Inner Suburb Study Area																
Beckenham/Sydenham	555	1	1	25	2	3	63	0	1	13	0	0	0	2	4	100
Fendalton	745	3	4	23	7	9	54	2	3	16	1	1	7	13	17	100
Inner City	635	52	82	18	97	153	33	73	115	25	74	117	25	296	466	100
Linwood	754	1	2	25	3	4	62	1	1	13	0	0	0	5	6	100
Opawa/Woolston	798	28	35	17	46	58	28	39	49	24	49	61	30	162	203	100
Riccarton	349	1	4	25	3	10	62	1	2	13	0	0	0	6	16	100
Shirley	572	3	4	25	6	11	63	1	2	13	0	0	0	10	18	100
Spreydon/Addington	745	3	4	25	6	8	59	2	2	16	0	0	0	11	14	100
St Albans	864	2	2	25	5	5	62	1	1	13	0	0	0	7	9	100
Sub-total - Inner Suburb Study Area	6016	93	16	18	175	29	34	119	20	23	124	21	24	512	85	100
Outer Suburbs																
Addington Industrial	230	0	1	25	1	2	63	0	0	12	0	0	0	1	4	100
Airport	2088	11	5	25	26	13	62	5	3	13	0	0	0	42	20	100
Avonhead	727	30	41	22	56	77	41	33	46	24	17	23	13	135	186	100
Bishopdale	887	3	3	25	7	8	63	1	2	13	0	0	0	12	13	100
Bromley	764	2	2	25	5	6	61	1	1	14	0	0	0	7	10	100
Burnside/Bryndwr	460	0	0	25	0	1	63	0	0	13	0	0	0	1	2	100
Hoon Hay	421	12	28	18	20	46	29	16	38	24	20	47	30	67	159	100
Hornby	498	27	53	19	42	83	30	34	68	24	39	78	28	141	282	100
Marshlands	1135	1	1	25	2	2	63	0	0	13	0	0	0	3	2	100
New Avonhead	230	0	1	25	1	2	63	0	0	13	0	0	0	1	4	100
New Brighton	1942	2	1	25	5	3	63	1	1	13	0	0	0	8	4	100
Parklands	312	7	24	18	12	40	31	10	32	25	11	34	26	41	130	100
Racecourse	247	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
Redwood	752	2	3	25	6	7	63	1	1	13	0	0	0	9	12	100
Sockburn	264	3	13	17	5	21	27	5	18	24	6	23	31	20	75	100
Wigram	786	5	6	25	12	15	62	3	3	13	0	0	0	20	25	100
Sub-total	11741	105	9	21	199	17	39	111	9	22	93	8	18	506	43	100
Total - Total Study Area	17757	198	11	19	374	21	37	230	13	23	217	12	21	1018	57	100

Table 5.10 CO emissions produced at different times of a typical winter's day by industry across various suburb areas of Christchurch.

Suburb Area	Area (ha)	6am-10am			10am-4pm			4pm-10pm			10pm-6am			Daily Total		
		kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total
Inner Suburb Study Area																
Beckenham/Sydenham	555	0	1	25	1	2	63	0	0	13	0	0	0	1	3	100
Fendalton	745	2	2	24	4	5	55	1	1	15	0	1	6	7	9	100
Inner City	635	28	44	18	54	86	35	37	58	24	36	57	23	155	245	100
Linwood	754	1	1	25	3	3	62	1	1	13	0	0	0	4	6	100
Opawa/Woolston	798	8	10	20	15	19	38	8	10	21	9	11	21	40	50	100
Riccarton	349	1	2	25	2	6	62	0	1	13	0	0	0	3	10	100
Shirley	572	1	2	25	3	6	63	1	1	13	0	0	0	5	9	100
Spreydon/Addington	745	2	2	25	4	5	60	1	1	15	0	0	0	6	8	100
St Albans	864	1	1	25	3	4	62	1	1	13	0	0	0	5	6	100
Sub-total - Inner Suburb Study Area	6016	44	7	19	89	15	39	49	8	22	45	7	20	228	38	100
Outer Suburbs																
Addington Industrial	230	0	2	25	1	4	63	0	1	12	0	0	0	2	7	100
Airport	2088	1	0	23	1	1	44	1	0	24	0	0	9	2	1	100
Avonhead	727	23	32	19	40	55	34	29	40	25	26	36	22	118	163	100
Bishopdale	887	2	2	25	5	5	63	1	1	13	0	0	0	7	8	100
Bromley	764	2	2	25	5	6	61	1	1	14	0	0	0	8	10	100
Burnside/Bryndwr	460	0	0	25	0	1	63	0	0	13	0	0	0	0	1	100
Hoon Hay	421	5	13	18	9	22	29	7	17	24	9	22	29	31	74	100
Hornby	498	7	13	23	11	23	39	6	12	21	5	9	16	29	57	100
Marshlands	1135	0	0	25	1	1	63	0	0	13	0	0	0	2	2	100
New Avonhead	230	0	1	25	0	2	63	0	0	13	0	0	0	1	3	100
New Brighton	1942	2	1	25	4	2	63	1	0	13	0	0	0	7	3	100
Parklands	312	3	9	17	5	15	27	4	13	24	5	17	31	17	55	100
Racecourse	247	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
Redwood	752	1	2	25	4	5	63	1	1	13	0	0	0	6	7	100
Sockburn	264	2	7	18	3	12	32	2	8	23	3	10	27	10	37	100
Wigram	786	3	4	25	7	9	60	2	2	15	0	0	0	12	15	100
Sub-total	11741	51	4	20	96	8	38	55	5	22	48	4	19	250	21	100
Total - Total Study Area	17757	95	5	20	185	10	39	105	6	22	93	5	20	478	27	100

Table 5.11 NO_x emissions produced at different times of a typical winter's day by industry across various suburb areas of Christchurch.

Suburb Area	Area (ha)	6am-10am			10am-4pm			4pm-10pm			10pm-6am			Daily Total		
		kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total
Inner Suburb Study Area																
Beckenham/Sydenham	555	1	2	25	3	6	63	1	1	13	0	0	0	5	10	100
Fendalton	745	5	7	23	12	16	55	3	4	15	1	2	6	22	29	100
Inner City	635	101	160	18	195	308	35	132	208	24	130	204	23	558	880	100
Linwood	754	3	4	25	7	9	62	1	2	13	0	0	0	11	14	100
Opawa/Woolston	798	30	37	20	57	72	38	31	39	21	32	40	21	150	187	100
Riccarton	349	3	9	25	8	23	62	2	5	13	0	0	0	13	37	100
Shirley	572	4	8	25	11	19	63	2	4	13	0	0	0	17	30	100
Spreydon/Addington	745	6	8	25	13	18	60	3	5	15	0	0	0	22	30	100
St Albans	864	4	5	25	11	12	62	2	3	13	0	0	0	17	20	100
Sub-total - Inner Suburb Study Area	6016	157	26	19	318	53	39	178	30	22	163	27	20	815	136	100
Outer Suburbs																
Addington Industrial	230	1	6	25	3	14	63	1	3	12	0	0	0	5	23	100
Airport	2088	2	1	23	5	2	44	2	1	24	1	0	9	10	5	100
Avonhead	727	38	52	24	76	104	49	37	51	24	5	6	3	155	213	100
Bishopdale	887	7	8	25	17	20	63	3	4	13	0	0	0	28	31	100
Bromley	764	7	9	25	17	22	61	4	5	14	0	0	0	28	37	100
Burnside/Bryndwr	460	0	1	25	1	2	63	0	0	13	0	0	0	2	3	100
Hoon Hay	421	20	47	18	33	78	29	26	62	24	33	77	29	111	263	100
Hornby	498	24	48	23	41	83	39	22	45	21	17	35	16	105	211	100
Marshlands	1135	2	1	25	4	4	63	1	1	13	0	0	0	7	6	100
New Avonhead	230	1	3	25	2	7	63	0	1	13	0	0	0	3	11	100
New Brighton	1942	6	3	25	15	8	63	3	2	13	0	0	0	24	12	100
Parklands	312	12	39	18	20	64	29	17	53	24	19	62	28	68	217	100
Racecourse	247	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
Redwood	752	5	6	25	12	16	63	2	3	13	0	0	0	19	25	100
Sockburn	264	6	21	18	9	35	29	8	29	24	10	36	30	32	122	100
Wigram	786	10	13	25	24	31	60	6	8	15	0	0	0	41	52	100
Sub-total	11741	140	12	22	279	24	44	133	11	21	84	7	13	637	54	100
Total - Total Study Area	17757	298	17	20	597	34	41	311	17	21	247	14	17	1452	82	100

Table 5.12 SO_x emissions produced at different times of a typical winter's day by industry across various suburb areas of Christchurch.

Suburb Area	Area (ha)	6am-10am			10am-4pm			4pm-10pm			10pm-6am			Daily Total		
		kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total
Inner Suburb Study Area																
Beckenham/Sydenham	555	3	5	25	6	12	63	1	2	13	0	0	0	10	18	100
Fendalton	745	10	14	23	24	33	55	7	9	15	3	4	7	45	60	100
Inner City	635	192	303	18	365	575	34	260	410	24	262	412	24	1079	1701	100
Linwood	754	5	6	25	12	15	62	2	3	13	0	0	0	18	25	100
Opawa/Woolston	798	54	67	19	102	128	37	59	73	21	62	77	22	276	346	100
Riccarton	349	6	17	25	15	43	62	3	9	13	0	0	0	24	70	100
Shirley	572	9	16	25	22	39	63	4	8	13	0	0	0	36	63	100
Spreydon/Addington	745	11	15	25	26	35	60	7	9	15	0	0	0	43	58	100
St Albans	864	8	9	25	20	23	62	4	5	13	0	0	0	32	37	100
Sub-total - Inner Suburb Study Area	6016	297	49	19	592	98	38	348	58	22	326	54	21	1564	260	100
Outer Suburbs																
Addington Industrial	230	1	5	25	3	13	63	1	3	12	0	0	0	5	21	100
Airport	2088	3	2	23	6	3	46	3	2	24	1	0	7	14	7	100
Avonhead	727	75	104	25	154	211	51	72	99	24	1	1	0	302	415	100
Bishopdale	887	12	14	25	31	34	63	6	7	13	0	0	0	49	55	100
Bromley	764	11	15	25	28	36	61	6	8	14	0	0	0	45	59	100
Burnside/Bryndwr	460	1	2	25	2	4	63	0	1	13	0	0	0	3	7	100
Hoon Hay	421	42	99	18	69	164	29	56	132	24	69	165	29	236	560	100
Hornby	498	93	186	19	148	297	31	114	230	24	129	259	27	484	972	100
Marshlands	1135	3	3	25	8	7	63	2	1	13	0	0	0	12	11	100
New Avonhead	230	1	5	25	3	12	63	1	2	13	0	0	0	5	20	100
New Brighton	1942	10	5	25	26	13	63	5	3	13	0	0	0	41	21	100
Parklands	312	20	66	17	32	103	27	29	93	24	38	120	31	119	382	100
Racecourse	247	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
Redwood	752	9	12	25	22	30	63	4	6	13	0	0	0	36	48	100
Sockburn	264	11	43	17	18	69	28	16	60	24	20	76	31	65	248	100
Wigram	786	19	24	25	46	59	61	10	13	14	0	0	0	75	95	100
Sub-total	11741	312	27	21	595	51	40	325	28	22	258	22	17	1491	127	100
Total - Total Study Area	17757	609	34	20	1188	67	39	673	38	22	584	33	19	3055	172	100

Table 5.13 VOC emissions produced at different times of a typical winter's day by industry across various suburb areas of Christchurch.

Suburb Area	Area (ha)	6am-10am			10am-4pm			4pm-10pm			10pm-6am			Daily Total		
		kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total
Inner Suburb Study Area																
Beckenham/Sydenham	555	1	2	25	3	6	63	1	1	13	0	0	0	5	10	100
Fendalton	745	0	0	24	0	0	59	0	0	14	0	0	3	0	0	100
Inner City	635	35	55	25	86	136	61	19	31	14	1	2	1	142	223	100
Linwood	754	5	7	25	13	17	61	3	4	14	0	0	0	21	27	100
Opawa/Woolston	798	17	21	24	40	50	59	10	12	14	2	3	3	68	85	100
Riccarton	349	0	1	25	1	3	52	0	1	23	0	0	0	2	6	100
Shirley	572	0	0	25	0	0	63	0	0	13	0	0	0	0	0	100
Spreydon/Addington	745	9	12	25	22	30	61	5	7	14	0	0	0	37	50	100
St Albans	864	1	1	25	2	2	62	0	0	13	0	0	0	3	4	100
Sub-total - Inner Suburb Study Area	6016	69	11	25	168	28	60	39	6	14	3	1	1	279	46	100
Outer Suburbs																
Addington Industrial	230	1	6	25	3	15	63	1	3	12	0	0	0	6	24	100
Airport	2088	1	1	25	3	1	60	1	0	14	0	0	1	5	2	100
Avonhead	727	1	2	18	2	3	30	2	2	24	2	3	28	7	10	100
Bishopdale	887	1	1	25	2	2	63	0	0	13	0	0	0	3	4	100
Bromley	764	13	18	25	32	42	60	8	11	15	0	0	0	54	70	100
Burnside/Bryndwr	460	0	0	25	0	0	63	0	0	13	0	0	0	0	0	100
Hoon Hay	421	1	3	24	4	8	58	1	2	14	0	1	4	6	14	100
Hornby	498	60	120	17	92	186	26	86	173	25	113	226	32	351	705	100
Marshlands	1135	1	1	25	2	2	63	0	0	13	0	0	0	3	2	100
New Avonhead	230	0	0	25	0	0	63	0	0	13	0	0	0	0	0	100
New Brighton	1942	9	4	25	21	11	63	4	2	13	0	0	0	34	18	100
Parklands	312	0	0	18	0	0	32	0	0	23	0	0	27	0	2	100
Racecourse	247	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
Redwood	752	2	3	25	5	7	63	1	1	13	0	0	0	8	11	100
Sockburn	264	2	8	24	5	20	57	1	5	14	0	2	5	9	35	100
Wigram	786	8	10	25	17	22	52	7	9	23	0	0	0	33	42	100
Sub-total	11741	101	9	19	190	16	37	113	10	22	115	10	22	519	44	100
Total - Total Study Area	17757	170	10	21	358	20	45	152	9	19	118	7	15	798	45	100

Table 5.14 CO_2 emissions produced at different times of a typical winter's day by industry across various suburb areas of Christchurch.

Suburb Area	Area (ha)	6am-10am			10am-4pm			4pm-10pm			10pm-6am			Daily Total		
		kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total	kg	g/ha	% Daily Total
Inner Suburb Study Area																
Beckenham/Sydenham	555	706	1272	25	1765	3181	63	353	636	13	0	0	0	2823	5090	100
Fendalton	745	2029	2724	24	4842	6499	57	1244	1670	15	401	539	5	8516	11431	100
Inner City	635	44214	69671	20	93719	147680	43	45677	71977	21	36581	57643	17	220191	346971	100
Linwood	754	2117	2808	25	5289	7016	62	1062	1409	13	0	0	0	8468	11233	100
Opawa/Woolston	798	19707	24686	21	41386	51842	44	17689	22158	19	15273	19132	16	94055	117818	100
Riccarton	349	1927	5521	25	4683	13417	61	1098	3146	14	0	0	0	7709	22085	100
Shirley	572	1533	2678	25	3831	6694	63	766	1339	13	0	0	0	6130	10711	100
Spreydon/Addington	745	3035	4076	25	7406	9946	61	1699	2281	14	0	0	0	12139	16303	100
St Albans	864	2766	3203	25	6850	7931	62	1449	1678	13	0	0	0	11066	12813	100
Sub-total - Inner Suburb Study Area	6016	78034	12971	21	169771	28219	46	71037	11808	19	52255	8686	14	371098	61683	100
Outer Suburbs																
Addington Industrial	230	1515	6603	25	3768	16423	63	739	3223	12	0	0	0	6023	26249	100
Airport	2088	2689	1288	23	5240	2510	44	2830	1356	24	1037	497	9	11796	5651	100
Avonhead	727	18387	25305	21	33930	46696	38	21188	29159	24	14719	20257	17	88225	121417	100
Bishopdale	887	4428	4995	25	11070	12487	63	2214	2497	13	0	0	0	17712	19979	100
Bromley	764	6517	8530	25	15886	20792	61	3666	4798	14	0	0	0	26070	34121	100
Burnside/Bryndwr	460	188	410	25	471	1024	63	94	205	13	0	0	0	753	1639	100
Hoon Hay	421	5936	14088	18	10092	23949	30	7689	18247	23	9442	22406	28	33159	78689	100
Hornby	498	10035	20148	23	19156	38462	43	8752	17573	20	6298	12645	14	44241	88827	100
Marshlands	1135	1054	929	25	2636	2322	63	527	464	13	0	0	0	4217	3715	100
New Avonhead	230	507	2203	25	1267	5507	63	253	1101	13	0	0	0	2027	8811	100
New Brighton	1942	4760	2452	25	11900	6129	63	2380	1226	13	0	0	0	19040	9806	100
Parklands	312	3076	9854	18	5108	16362	29	4105	13150	24	5099	16333	29	17389	55698	100
Racecourse	247	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
Redwood	752	2648	3524	25	6621	8810	63	1324	1762	13	0	0	0	10593	14095	100
Sockburn	264	2510	9500	19	4546	17207	35	2974	11258	23	3122	11818	24	13152	49784	100
Wigram	786	5847	7442	25	13491	17172	58	4050	5156	17	0	0	0	23388	29770	100
Sub-total	11741	70098	5970	22	145181	12365	46	62788	5348	20	39718	3383	12	317786	27066	100
Total - Total Study Area	17757	148132	8342	22	314953	17736	46	133825	7536	19	91974	5179	13	688883	38794	100

6. Combined Emissions

6.1. How do Industrial Emissions Compare with Motor Vehicle Emissions and Home Heating Emissions?

In both the total study area and the inner suburb study area, 82% of PM_{10} emissions to the air on a typical winter's day result from domestic solid fuel heating. Approximately 90% of NO_x emissions, ~65%-70% of CO and VOC and nearly 60% of CO_2 emissions are derived from motor vehicles. Almost 50% of SO_x emissions stem from industry and a further third is derived from home heating. (Table 6.1, Table 6.2 and Figure 6.1).

In 96% of the suburbs (the results of which can be found in Appendix III), more PM_{10} emissions to the air on a typical winter's day result from domestic solid fuel heating than from motor vehicles or industry. Motor vehicles emit more CO, NO_x, VOC and CO_2 than home heating or industry in 80%, 96%, 76% and 88% of the suburbs respectively. In 13 of the 25 suburbs (52%), more SO_x is emitted from home heating than from motor vehicles or industry.

The combined emissions for the various study areas do not account for variations in local air quality that result from differing dispersion methods. Pollutants emitted from domestic home heating are expected to produce more uniform concentrations throughout the airshed because of greater regularity between sources and the height at which the pollutants are released. Motor vehicle and industrial emissions however, can result in much higher local concentrations. Pollutants from motor vehicles tend to be released at exhaust height and are usually concentrated along the narrow corridors of the roading system within a suburb area. Industrial emissions tend to be released from single point sources with an area.

Another factor that also needs to be noted when considering PM_{10} emissions from motor vehicles is that the calculations used in this study only relate to emissions of primary particulate direct from the vehicle exhaust. Other pollutants emitted from motor vehicles, such as sulphur oxides and nitrogen oxides, can react later in the atmosphere to form secondary particulate. While quantifying this effect is outside the scope of this project, the contribution from this source is expected to be relatively minor compared to the contribution from domestic fires.

Table 6.1 Home heating, motor vehicle and industry emissions for the total study area.

	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating	10971	618	82	61962	3489	33	937	53	4	2490	140	37	15490	872	34	1375853	77482	28
Motor Vehicles	1365	77	10	125591	7073	67	23655	1332	91	1130	64	17	28608	1611	64	2802943	157849	58
Industry	1018	57	8	478	27	0	1452	82	6	3055	172	46	798	45	2	688883	38794	14
Total	13354	752	100	188031	10589	100	26044	1467	100	6675	376	100	44896	2528	100	4867679	274122	100

Table 6.2 Home heating, motor vehicle and industry emissions for the inner suburb study area.

	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating	5585	928	82	31086	5167	30	472	79	4	1293	215	37	7772	1292	32	681470	113274	27
Motor Vehicles	747	124	11	73896	12283	70	12162	2022	90	613	102	18	16381	2723	67	1505008	250163	59
Industry	512	85	7	228	38	0	815	136	6	1564	260	45	279	46	1	371098	61683	15
Total	6844	1138	100	105210	17488	100	13449	2236	100	3470	577	100	24432	4061	100	2557576	425122	100

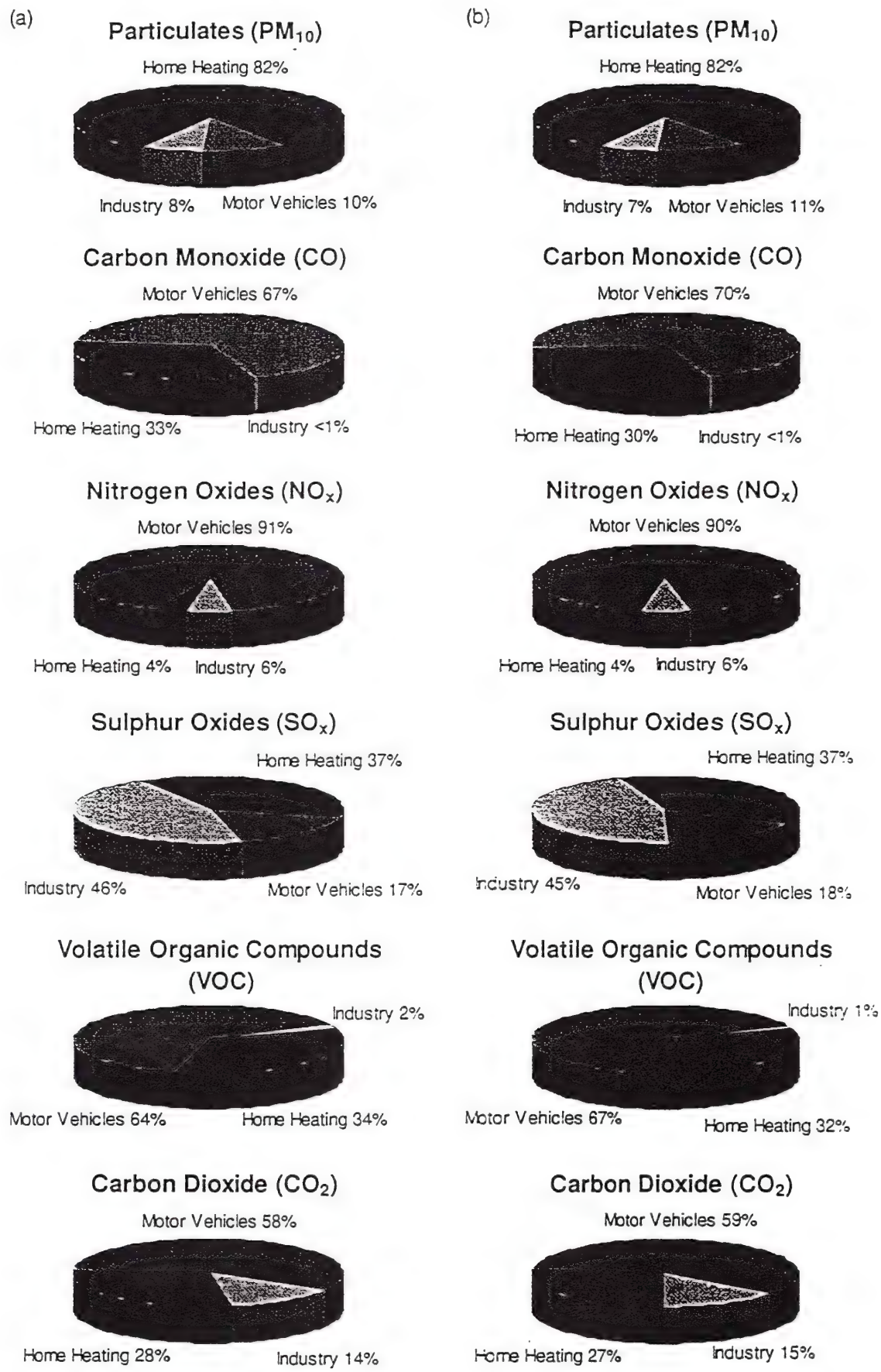


Figure 6.1 Comparison of home heating and motor vehicle emissions of PM_{10}, CO, NO_x, SO_x, VOC, and CO_2 for a typical winter's day for (a) the total study area and (b) the inner suburb study area.

6.2. How do Combined Emissions vary with the Time of Day?

Across the total study area, combined home heating, motor vehicle and industrial PM_{10}, CO, SO_x, VOC and CO_2 emissions peak between the hours of 4pm-10pm (which also coincides with the onset of temperature inversion conditions) (Table 6.3 and Figure 6.2(a)). Combined NO_x emissions peak between 10am and 4pm (which coincides with high VKT's from Table 4.8). Combined PM_{10} emissions are at their lowest between 6am-10am while combined CO, NO_x, SO_x, VOC and CO_2 emissions drop off between 10pm-6am (which also coincides with lower VKT's from Table 4.8).

Within the inner suburb study area, combined PM_{10} emissions are at their lowest between the hours of 6am and 10am (Table 6.4 and Figure 6.2(b)). Like the total study area, all the other pollutants are at their lowest between 10pm and 6am. Combined PM_{10}, CO, SO_x, VOC and CO_2 emissions all peak between 4pm and 10pm. Combined NO_x emissions again peak between 10am and 4pm (which coincides with high VKT's from Table 4.8).

This pattern for combined emissions is slightly different to that of the separate source emissions (Table 6.3 and Table 6.4). Solid fuel heating emissions of PM_{10}, CO, NO_x, SO_x, VOC and CO_2 peak between 4pm-10pm and are at their lowest between 6am-10am in both the total study area and the inner suburb study area. The peak period for all motor vehicle emissions and industry however, tends to occur between 10am-4pm. The low period for motor vehicle emissions occurs from 10pm-6am while for industry it tends to occur between 10pm and 10am.

Across the individual suburbs, combined motor vehicle, solid fuel heating and industrial PM_{10}, CO, SO_x and VOC emissions peak between the hours of 4pm-10pm in over 60% of suburbs (Appendix III). Furthermore, for PM_{10} the peak period between 4pm and 10pm is recorded in all suburbs but the Airport (96%). Combined CO_2 emissions peak between 4pm and 10pm in 56% of the suburbs while NO_x peaks between 10am and 4pm in all suburbs. Combined CO, NO_x, VOC and CO_2 emissions drop off between 10pm and 6am in over 85% of the suburbs. 60% of the suburbs record the low period for SO_x between 10pm and 6am while 40% record it between 6am and 10am. For PM_{10}, 52% of suburbs recorded the low emission period between the hours of 6am and 10am while in 48% of suburbs it was between 10pm and 6am.

Table 6.3 Combined estimated pollutant emissions for various times of a typical winter's day across the total study area.

	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	788	44	7	4388	247	7	67	4	7	187	11	8	1097	62	7	103073	5805	7
10am-4pm	1623	91	15	9096	512	15	138	8	15	377	21	15	2274	128	15	205651	11581	15
4pm-10pm	7201	406	66	40485	2280	65	613	35	65	1640	92	66	10121	570	65	887048	49955	64
10pm-6am	1360	77	12	7992	450	13	119	7	13	286	16	11	1998	113	13	180081	10141	13
Total	10971	618	100	61962	3489	100	937	53	100	2490	140	100	15490	872	100	1375853	77482	100
Motor Vehicles																		
6am-10am	297	17	22	27559	1552	22	5112	288	22	246	14	22	6257	352	22	608628	34275	22
10am-4pm	609	34	45	56566	3186	45	10478	590	44	504	28	45	12839	723	45	1247927	70278	45
4pm-10pm	394	22	29	36362	2048	29	6820	384	29	326	18	29	8275	466	29	809130	45567	29
10pm-6am	65	4	5	5104	287	4	1246	70	5	54	3	5	1236	70	4	137258	7730	5
Total	1365	77	100	125591	7073	100	23655	1332	100	1130	64	100	28608	1611	100	2802943	157849	100
Industry																		
6am-10am	198	11	19	95	5	20	298	17	20	609	34	20	170	10	21	148132	8342	22
10am-4pm	374	21	37	185	10	39	597	34	41	1188	67	39	358	20	45	314953	17736	46
4pm-10pm	230	13	23	105	6	22	311	17	21	673	38	22	152	9	19	133825	7536	19
10pm-6am	217	12	21	93	5	20	247	14	17	584	33	19	118	7	15	91974	5179	13
Total	1018	57	100	478	27	100	1452	82	100	3055	172	100	798	45	100	688883	38794	100
Combined Total																		
6am-10am	1283	72	10	32042	1804	17	5477	308	21	1042	59	16	7524	424	17	859833	48421	18
10am-4pm	2606	147	20	65847	3708	35	11213	631	43	2069	116	31	15471	871	34	1768531	99594	36
4pm-10pm	7825	441	59	76952	4334	41	7744	436	30	2639	149	40	18548	1045	41	1830003	103056	38
10pm-6am	1642	92	12	13189	743	7	1612	91	6	924	52	14	3352	189	7	409313	23050	8
Total	13354	752	100	188031	10589	100	26044	1467	100	6675	376	100	44896	2528	100	4867679	274122	100

Table 6.4 Combined estimated pollutant emissions for various times of a typical winter's day within the inner suburb study area.

	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	384	64	7	2117	352	7	32	5	7	93	15	7	529	88	7	49614	8247	7
10am-4pm	751	125	13	4378	728	14	66	11	14	161	27	12	1094	182	14	95681	15904	14
4pm-10pm	3922	652	70	21414	3559	69	327	54	69	932	155	72	5353	890	69	463559	77053	68
10pm-6am	528	88	9	3177	528	10	47	8	10	107	18	8	794	132	10	72616	12070	11
Total	5585	928	100	31086	5167	100	472	79	100	1293	215	100	7772	1292	100	681470	113274	100
Motor Vehicles																		
6am-10am	162	27	22	16125	2680	22	2632	437	22	133	22	22	3569	593	22	326621	54291	22
10am-4pm	335	56	45	33260	5528	45	5429	902	45	274	46	45	7361	1224	45	673691	111981	45
4pm-10pm	214	36	29	21305	3541	29	3478	578	29	176	29	29	4715	784	29	431547	71732	29
10pm-6am	35	6	5	3205	533	4	623	104	5	29	5	5	735	122	4	73149	12159	5
Total	747	124	100	73896	12283	100	12162	2022	100	613	102	100	16381	2723	100	1505008	250163	100
Industry																		
6am-10am	93	16	18	44	7	19	157	26	19	297	49	19	69	11	25	78034	12971	21
10am-4pm	175	29	34	89	15	39	318	53	39	592	98	38	168	28	60	169771	28219	46
4pm-10pm	119	20	23	49	8	22	178	30	22	348	58	22	39	6	14	71037	11808	19
10pm-6am	124	21	24	45	7	20	163	27	20	326	54	21	3	1	1	52255	8686	14
	512	85	100	228	38	100	815	136	100	1564	260	100	279	46	100	371098	61683	100
Combined Total																		
6am-10am	639	106	9	18286	3040	17	2821	469	21	523	87	15	4167	693	17	454269	75509	18
10am-4pm	1261	210	18	37727	6271	36	5813	966	43	1027	171	30	8623	1433	35	939143	156105	37
4pm-10pm	4255	707	62	42768	7109	41	3983	662	30	1456	242	42	10107	1680	41	966143	160593	38
10pm-6am	687	114	10	6427	1068	6	833	138	6	462	77	13	1532	255	6	198020	32915	8
Total	6844	1138	100	105210	17488	100	13449	2236	100	3470	577	100	24432	4061	100	2557576	425122	100

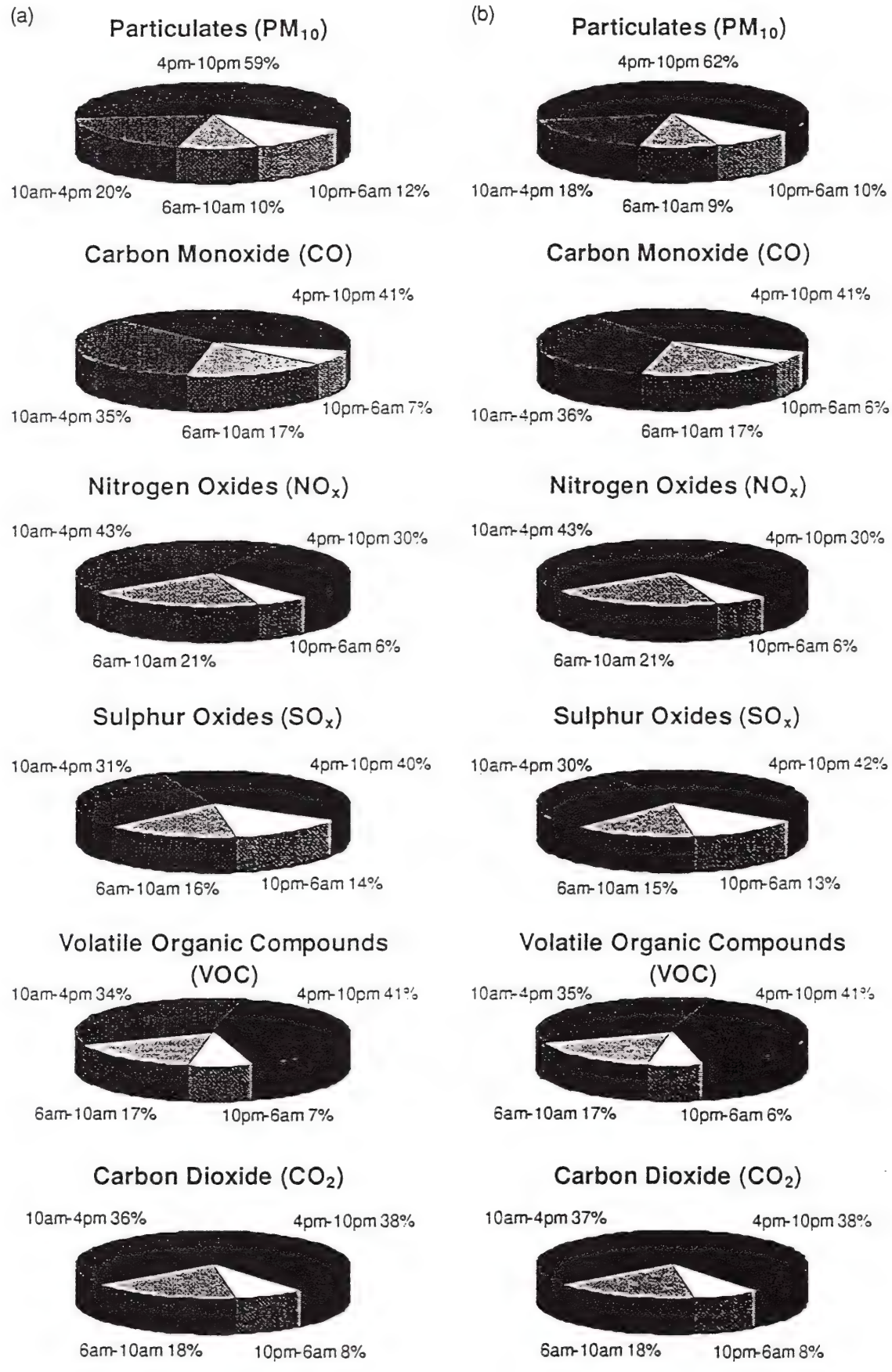


Figure 6.2 Comparison of home heating, motor vehicle and industrial PM_{10}, CO, NO_x, SO_x, VOC and CO_2 emissions for various times of a typical winter's day for (a) the total study area and (b) the inner suburb study area.

6.3. Aircraft Emissions *

Emissions associated with aircraft have been estimated separately based on the methodology by Wright and Kuschel ("Transport Inventory for New Zealand" NIWA report AK96049). Aircraft emissions have been calculated for "take off and landing cycles" only. Emissions outside this time period were excluded, as their effects on the airshed were considered negligible because of the altitude of emissions. From the national report on transport emissions the annual aircraft emissions for Christchurch City were estimated, in tonnes per year, to be:

CO_2	CO	VOC	NOx	SOx	PM_{10}
22,797	171	30.87	65.18	7.24	2.62

Assuming constant emissions every day, the annual figure was divided by 365 to get daily aircraft emissions in kg/day as follows:

CO_2	CO	VOC	NOx	SOx	PM_{10}
62,458	468	85	179	20	7

These emissions were broken down further by time of day and type of flight (national versus international) using information provided by Christchurch airport flight schedules. This breakdown of emissions for domestic and international aircraft and concentrations on a gram per hectare basis (relative to the area of the Airport suburb – 2088 hectares) are in Appendix VI.

Table 6.5 provides a comparison of aircraft emissions with emissions from other sources and a new combined total for the total study area (taking into account the additional aircraft emissions). Aircraft emissions as a percentage of the combined total emissions and as a percentage of the "Airport suburb" emissions are also include in Table 6.5.

Because of the minor contribution of aircraft emissions to the total study area indicated (less than 0.7% except CO_2 – 1.3%) no adjustments have been made to other tables in the emissions inventory for the total study area. However the impact of aircraft emission on "Airport suburb" emissions is more significant i.e. 7% of PM_{10}, approx. 20% for CO and NOx emissions and 28% for SOx emissions. and should be taken into account in assessing the breakdown of emissions and sources for this suburb.

* Addition to report June 1998

Table 6.5 Combined estimated pollutant emissions for various times of a typical winter's day across the total study area including aircraft emissions.

	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	788	44	7	4388	247	7	67	4	7	187	11	8	1097	62	7	103073	5805	7
10am-4pm	1623	91	15	9096	512	15	138	8	15	377	21	15	2274	128	15	205651	11581	15
4pm-10pm	7201	406	66	40485	2280	65	613	35	65	1640	92	66	10121	570	65	887048	49955	64
10pm-6am	1360	77	12	7992	450	13	119	7	13	286	16	11	1998	113	13	180081	10141	13
Total	10971	618	100	61962	3489	100	937	53	100	2490	140	100	15490	872	100	1375853	77482	100
Motor Vehicles																		
6am-10am	297	17	22	27559	1552	22	5112	288	22	246	14	22	6257	352	22	608628	34275	22
10am-4pm	609	34	45	56566	3186	45	10478	590	44	504	28	45	12839	723	45	1247927	70278	45
4pm-10pm	394	22	29	36362	2048	29	6820	384	29	326	18	29	8275	466	29	809130	45567	29
10pm-6am	65	4	5	5104	287	4	1246	70	5	54	3	5	1236	70	4	137258	7730	5
Total	1365	77	100	125591	7073	100	23655	1332	100	1130	64	100	28608	1611	100	2802943	157849	100
Industry																		
6am-10am	198	11	19	95	5	20	298	17	20	609	34	20	170	10	21	148132	8342	22
10am-4pm	374	21	37	185	10	39	597	34	41	1188	67	39	358	20	45	314953	17736	46
4pm-10pm	230	13	23	105	6	22	311	17	21	673	38	22	152	9	19	133825	7536	19
10pm-6am	217	12	21	93	5	20	247	14	17	584	33	19	118	7	15	91974	5179	13
Total	1018	57	100	478	27	100	1452	82	100	3055	172	100	798	45	100	688883	38794	100
Aircraft																		
6am-10am	2	0.009	23	107	6.0	23	41	2.3	23	5	0.3	23	19	1.1	23	14276	804	23
10am-4pm	2	0.14	34	161	9.0	34	61	3.5	34	7	0.4	34	29	1.6	34	21414	1206	34
4pm-10pm	2	0.14	34	161	9.0	34	61	3.5	34	7	0.4	34	29	1.6	34	21414	1206	34
10pm-6am	1	0.03	9	40	2.3	9	15	.9	9	2	0.1	9	7	0.4	9	5354	301	9
Total	7	0.39	100	468	26.4	100	179	10.1	100	20	1.1	100	85	4.8	100	62458	3517	100
Combined Total																		
6am-10am	1285	72	10	32149	1810	17	5518	311	21	1047	60	16	7543	425	17	874109	49226	18
10am-4pm	2608	146	20	66007	3717	35	11274	635	43	2075	116	31	15500	873	34	1789945	100801	36
4pm-10pm	7827	441	59	77112	4343	41	7805	440	30	2646	148	40	18577	1046	41	1851417	104264	38
10PM_{10}-6am	1642	93	12	13229	745	7	1627	92	6	926	52	14	3360	190	7	414666	23352	8
Total	13361	753	100	188499	10615	100	26223	1477	100	6695	377	100	44981	2533	100	4930137	277643	100
Aircraft Emissions as a percentage of Combined Total																		
6am-10am	0.12	0.12		0.3	0.3		0.7	0.7		0.4	0.4		0.3	0.3		1.6	1.6	
10am-4pm	0.09	0.09		0.2	0.2		0.5	0.5		0.3	0.3		0.2	0.2		1.2	1.2	
4pm-10pm	0.03	0.03		0.2	0.2		0.8	0.8		0.3	0.3		0.2	0.2		1.2	1.2	
10pm-6am	0.04	0.04		0.3	0.3		0.9	0.9		0.2	0.2		0.2	0.2		1.3	1.3	
Total	0.05	0.05		0.2	0.2		0.7	0.7		0.3	0.3		0.2	0.2		1.3	1.3	

Christchurch Inventory of Total Emissions

	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Total Airport suburb emissions including Aircraft emissions																		
6am-10am	22	11	22	591	283	22	247	119	22	16	8	22	160	76	22	37149	17793	22
10am-4pm	49	23	48	1097	526	41	461	221	42	29	14	41	303	145	42	65761	31497	40
4pm-10pm	26	13	26	816	391	31	329	158	30	22	11	31	218	104	30	51129	24489	31
10pm-6am	4	2	4	154	74	6	62	30	6	5	2	7	40	19	6	11083	5309	7
Total	102	49	100	2658	1273	100	1099	526	100	73	34	100	721	346	100	165121	79088	100
Aircraft Emissions as a percentage of Airport suburb emissions																		
6am-10am	7	7		18	18		17	17		29	29		12	12		38	38	
10am-4pm	5	5		15	15		13	13		23	23		10	10		33	33	
4pm-10pm	9	9		20	20		19	19		31	31		13	13		42	42	
10pm-6am	15	15		26	26		25	25		35	35		18	18		48	48	
Total	7	7		18	18		16	16		28	28		12	12		38	38	

7. Key Findings

From this study the following key results have been identified:

Methods of Home Heating:

- Multiple methods of home heating occur within the main living area of the same household on a typical winter's day.
- Electricity is used by 68% and 71% of household in the total study area and within the inner suburb study area respectively to heat the main living area on a typical winter's day while 28% and 23% of households use woodburners.
- Across the total study area approximately 13240 households use an open fire on a typical winter's day to heat the main living area. This equates to approximately 14% of the total number of households in the total study area, and nearly 31% of solid fuel burning appliances in use.
- Within the total study area there are approximately 26160 households using woodburners to heat the main living area on a typical winter's day (approximately 28% of the total number of households in the total study area and nearly 61% of solid fuel burning appliances in use).
- 50% of the households that use woodburners, had them installed prior to 1989, approximately 23% were installed between 1989 and 1992 while over 25% have been installed since 1993.

Wood and Coal Use:

- By weight, the use of wood on a typical winter's day within the total study area is approximately four and a half times greater that the use of coal (590 tonnes of wood compared to 132 tonnes of coal). Within the inner suburb area 69 tonnes of coal are burnt per day compared to 288 tonnes of wood.
- Across the total study area approximately 65% of the daily firewood consumption is burnt on woodburners, 31% on open fires, 2% on enclosed coal burners and 1% on incinerators. Nearly 60% of the daily coal consumption is burnt on open fires, 33% on enclosed coal burners, 5% on woodburners, 1% each on incinerators and pot bellies.
- Within the inner suburb study area, 59% of the daily wood consumption is burnt on woodburners compared with 38% on open fires. 64% of the daily coal consumption is burnt on open fires, 29% on enclosed coal burners, 3% on woodburners and 3% on incinerators.

Home Heating Emissions:

- The burning of wood and coal on open fires in the total study area is estimated to produce 48% of the home heating PM_{10} emissions while the burning of wood on woodburners produces 34%. 15% of PM_{10} emissions stem from the burning of wood and coal on enclosed coal burners.
- Within the inner suburb study area, 56% of PM_{10} emissions stem from the burning of wood and coal on open fires, 31% from woodburners, and 12% from enclosed coal burners.
- Across the total study area, open fires are responsible for approximately 43% of CO emissions, 45% of NO_x emissions, 57% of SO_x emissions, 43% of VOC emissions, and 39% of CO_2 emissions. Of those emissions, wood burning on an open fire produces 36% of CO emissions, 33% of NO_x emissions, 1% of SO_x emissions, 36% of VOC emissions, and 23% of CO_2 emissions. Coal burning on an open fire makes up the difference.
- The burning of wood on woodburners across the total study area produces approximately 49% of CO emissions, 45% of NO_x emissions, 4% of SO_x emissions, 49% of VOC emissions, and 49% of CO_2 emissions. Coal burning on woodburners contributes to a small percentage of CO_2 emissions (2%) and to over half of the SO_x emissions (5%).
- Within the inner suburb study area, the burning of wood and coal on an open fires produces 51% of CO emissions, 53% of NO_x emissions, 63% of SO_x emissions, 51% of VOC emissions, and 46% of CO_2 emissions. Of those emissions, wood burning on an open fire produces 43% of CO, 39% of NO_x, 2% of SO_x, 43% of VOC, and 28% of CO_2 emissions. Coal burning on an open fire makes up the difference (61% in the case of SO_x).

- The burning of wood and coal on woodburners produces approximately 43% of CO emissions, 39% of NO_x emissions, 6% of SO_x emissions, 43% of VOC emissions, and 44% of CO_2 emissions. Coal burning on woodburners contributes to a small percentage of CO_2 emissions (1%) and to half of the SO_x emissions (3%).
- Across the total study area, 32% of SO_x, 7% of NO_x, 9% of CO_2 comes from the burning of coal on enclosed coal burners. Within the inner suburb study area, 28% of SO_x, 6% of NO_x, 8% of CO_2 comes from the coal burning on these appliances.
- At the 95% confidence level, PM_{10} emissions are positively correlated with the use of open fires and to the use of enclosed coal burners. The relationship between PM_{10} and woodburners is significant at the 99% confidence level. CO is positively correlated to open fires and to woodburners at the 99% confidence level. SO_x emissions are positively correlated with the use of open fires, oil fires, pot bellies, and gas at the 95% confidence level and are correlated with the use of enclosed coal burners at the 99% confidence level
- The total study area is estimated to produce approximately 10971 kilograms of PM_{10} per day or 618 gram per hectare per day whereas the inner suburb study area is estimated to produce 51% of the total PM_{10} emissions (5585 kg/day). On a grams per hectare basis, the PM_{10} emissions from home heating within the inner suburb study area are 1.5 times greater than the total study area (928 g/ha/day compared to 618 g/ha/day).
- The inner suburb study area is estimated to produce 50% of the total CO, NO_x, VOC, and CO_2 emissions and 52% of the total SO_x. On a grams per hectare basis, the inner suburb study area produces 1.5 times more CO, NO_x, SO_x, VOC, and CO_2 than the total study area.
- On an individual suburb basis, PM_{10} emissions per hectare in Burnside/Bryndwr can be as much as 41 times larger than those in New Avonhead. CO and NO_x can be as much as 30 times larger, VOC 28 times larger, CO_2 20 times larger, and SO_x 450 times greater.
- Across the total study area, ~78% of PM_{10}, CO, NO_x, SO_x, VOC, and CO_2 are emitted between 4pm and 6am on a typical winter's night. The next highest period of emissions occurs between 10am and 4pm across all pollutants (15% of each pollutant released during this time).
- Within the inner suburb study area, ~80% of pollutants are emitted between 4pm and 6am on a typical winter's night. The next highest period of emissions occurs from 10am to 4pm across all pollutants (with 12%-14% released during this time).
- Both in the total study area and the inner suburb study area estimated PM_{10}, CO, NO_x, SO_x, VOC, and CO_2 emissions are lowest between the hours of 6am and 10am when ~7% of the total daily emissions are released

Motor Vehicle Emissions:

- Suburbs with larger vehicle kilometers travelled (VKT) values and more major traffic routes display higher emissions of the six pollutants than suburbs with lower VKT's values.
- Light duty petrol vehicles are the main emitters of CO (~90%), VOC (83%), and CO_2 (~70%). Heavy duty diesel vehicles tend to emit larger quantities of PM_{10} (65%) and SO_x (87%). A further 20% of CO_2 emissions stem from heavy duty diesel vehicles while nearly 30% of PM_{10} emissions are derived from light duty petrol vehicles. Both light duty petrol vehicles and heavy duty diesel vehicles release similar quantities of NO_x (50% and 46% respectively).
- On average, the inner suburb area produces 1.5-1.75 times the amount of all six pollutants per hectare per day when compared to the quantities produced by the total study area.
- The total study area is estimated to produce approximately 1365 kilograms of PM_{10} per day or 77 gram per hectare per day from motor vehicles whereas the inner suburb study area is estimated to produce 55% of the total PM_{10} emissions (747 kg/day). On a grams per hectare basis, the PM_{10} emissions from motor vehicles within the inner suburb study area are 1.6 times greater than the total study area (124 g/ha/day compared to 77 g/ha/day).
- The inner suburb study area is estimated to produce nearly 60% of the total CO and NO_x emissions from motor vehicles, 54% of the total SO_x and CO_2 emissions and 51% of the total NO_x emissions.

On a grams per hectare basis, the inner suburb study area produces 1.5 times more NO_x than the total study area, 1.6 times the SO_x and CO_2, and 1.7 times the CO and VOC.

- On an individual suburb basis, PM_{10} emissions per hectare in the Inner City are approximately 230 times larger than those in New Avonhead. CO and CO_2 can be as much as 350 times larger, NO_x and VOC 340 times larger, and SO_x 190 times greater.
- On average, approximately 45% of all motor vehicle emissions of PM_{10}, CO, NO_x, SO_x, VOC and CO_2 are released between the hours of 10am-4pm across the total study area. A secondary peak occurs between 4pm-10pm, during which ~30% of contaminants are emitted. A further 22% of pollutants are emitted between 6am-10am. Only 4-5% of all pollutants are emitted overnight (between 10pm-6am). This pattern is also a similar feature of the inner suburb area across all six pollutants, as well as in the majority of individual suburbs.
- The average estimated emissions per hectare from motor vehicles within the inner suburb area are 1.5-1.75 times the emissions of the total study area for all six pollutants.

Industrial Emissions:

- Across the total study area, Part A industries are the main emitters of PM_{10} (44%) and VOC (47%), while Part B industries emit larger quantities of CO (50%), NO_x (40%), and SO_x (39%). Part C industries emit nearly half the CO_2 (46%).
- Within the inner suburb study area, Part A industries are the main emitters of PM_{10} (46%), while Part B industries emit larger quantities of CO (37%), NO_x (37%), and SO_x (39%). Part C industries emit approximately 80% of VOC and over half the CO_2 (51%).
- On average, Part A industries within the inner suburb area produce approximately half of the kilogram per day figure for all pollutants except VOC (which produces approximately 20 times more per day). However on a per hectare basis, the inner suburb study area produces 1.6 times more PM_{10} per hectare than the total study area, 1.7 times the CO_2, 1.8 times the CO and NO_x and 1.3 times the SO_x. The total study area however, produces 7 times more VOC than the inner suburb study area.
- On a kilogram per day basis, Part B industries within the inner suburb area emit 40%-50% of the kg/day figure, yet on a per hectare basis they produce 1.3 times more PM_{10} and CO_2 than the total study area, 1.5 times the NO_x and SO_x, 1.2 times the VOC, and equal quantities of CO.
- Part C industries within the inner suburb area produce 1.8 times more PM_{10} per hectare than the total study area, 1.7 times the NO_x and SO_x, 1.9 times the VOC and CO, and 1.1 times the quantities of CO_2. On a kilogram per day basis they produce approximately half to a third of the total study area.
- The total study area is estimated to produce approximately 1018 kilograms of PM_{10} per day or 57 grams per hectare per day whereas the inner suburb study area is estimated to produce half the total PM_{10} emissions (512 kg/day). On a grams per hectare basis, the PM_{10} emissions from industry within the inner suburb study area are 1.5 times greater than the total study area (85 g/ha/day compared to 57 g/ha/day).
- The inner suburb study area is estimated to produce nearly 50% of the total CO emissions, ~55% of the total NO_x and CO_2 emissions, 51% of the total SO_x emissions, and 35% of the VOC emissions. On a grams per hectare basis, the inner suburb study area produces 1.4 times more CO than the total study area, 1.6 times the NO_x and CO_2, and 1.5 times the SO_x. VOC emissions per hectare are the same in both the total study area and the inner suburb study area.
- On an individual suburb basis, industrial emissions vary considerably from suburb to suburb. For example, when comparing the suburb of Racecourse with the Inner, PM_{10} emissions per hectare in the Inner City are approximately 450 times larger than those in the Racecourse. CO_2 can be as much as 350000 times larger, NO_x nearly 900 times larger, SO_x 1700 times greater, CO and VOC around 200 times larger.
- Pollutant concentrations are largely determined by the number and type of industries within a study area. Suburb areas with few or no industries tend to exhibit lower pollutant emissions per day whereas suburbs with a larger number of industries displayed higher pollutant concentrations.

- Across the total study area, ~40% of PM_{10}, CO, NO_x, and SO_x, and ~45% of VOC and CO_2 are released between the hours of 10am and 4pm on a typical winter's day. The remaining emissions are evenly spread between the three other time periods.
- Within the inner suburb study area, 34% to 39% of PM_{10}, CO, NO_x, and SO_x, 60% of VOC and 46% of CO_2 emissions are released between the hours of 10am and 4pm on a typical winter's day. With the exception of VOC, the remaining emissions are evenly spread between the three other time periods. For VOC, 25% of the emissions are released between 6am and 10am while 14% are emitted from 4pm to 10pm. 1% of VOC emissions are released from 10pm and 6am.
- On an individual suburb basis, PM_{10}, CO, NO_x, SO_x, VOC, and CO_2 emissions tended to peaked between the hours of 4pm and 10pm. In the suburbs where the peak was not between 4pm and 10pm, it occurred between 10pm an 6am.
- In ~70% of the suburbs, the next highest period of PM_{10}, CO, NO_x, SO_x, and CO_2 emissions occurred between 6am and 10am. For VOC, ~85% of the suburbs also displayed a secondary peak between 6am and 10am. Low PM_{10}, CO, and SO_x emissions were displayed between 10pm and 6am in ~75% of the suburbs. Over 80% of the suburbs displayed low NOx, CO2, and VOC between 10pm and 6am.

Combined Emissions:

- In the total study area and the inner suburb study area, 82% of PM_{10} emissions to the air on a typical winter's day result from domestic solid fuel heating. Approximately 90% of nitrogen oxide emissions, ~65%-70% of CO and VOC, and nearly 60% of CO_2 emissions are derived from motor vehicles. Almost 50% of SO_x emissions stem from industry and a further third is derived from home heating.
- In 96% of the suburbs, more PM_{10} emissions to the air on a typical winter's day result from domestic solid fuel heating than from motor vehicles or industry. Motor vehicles emit more CO, NO_x, VOC, and CO_2 than home heating or industry in 80%, 96%, 76%, and 88% of the suburbs respectively. In 13 of the 25 suburbs (52%), more SO_x is emitted from home heating than from motor vehicles or industry.
- Across the total study area, combined home heating, motor vehicle and industrial PM_{10}, CO, SO_x, VOC, and CO_2 emissions peak between the hours of 4pm-10pm. Combined NO_x emissions peak between 10am and 4pm. Combined PM_{10} emissions are at their lowest between 6am-10am while combined CO, NO_x, SO_x, VOC and CO_2 emissions drop off between 10pm-6am.
- Within the inner suburb study area, combined PM_{10} emissions are at their lowest between the hours of 6am and 10am. All other pollutants are at their lowest between 10pm and 6am. Combined PM_{10}, CO, SO_x, VOC and CO_2 emissions all peak between 4pm and 10pm. Combined NO_x peaks between 10am and 4pm.
- Across the individual suburbs, combined motor vehicle, solid fuel heating and industrial PM_{10}, CO, SO_x and VOC emissions peak between the hours of 4pm-10pm in over 60% of suburbs. Furthermore, for PM_{10} the peak period between 4pm and 10pm is recorded in all suburbs but the Airport (96%). Combined CO_2 emissions peak between 4pm and 10pm in 56% of the suburbs while NO_x peaks between 10am and 4pm in all suburbs. Combined CO, NO_x, VOC and CO_2 emissions drop off between 10pm-6am in over 85% of the suburbs. 60% of the suburbs record the low period for SO_x between 10pm and 6am while 40% record it between 6am-10am. For PM_{10} the low period for emissions is almost even between 6am-10am and 10pm-6am in 52% and 48% of the suburbs respectively.

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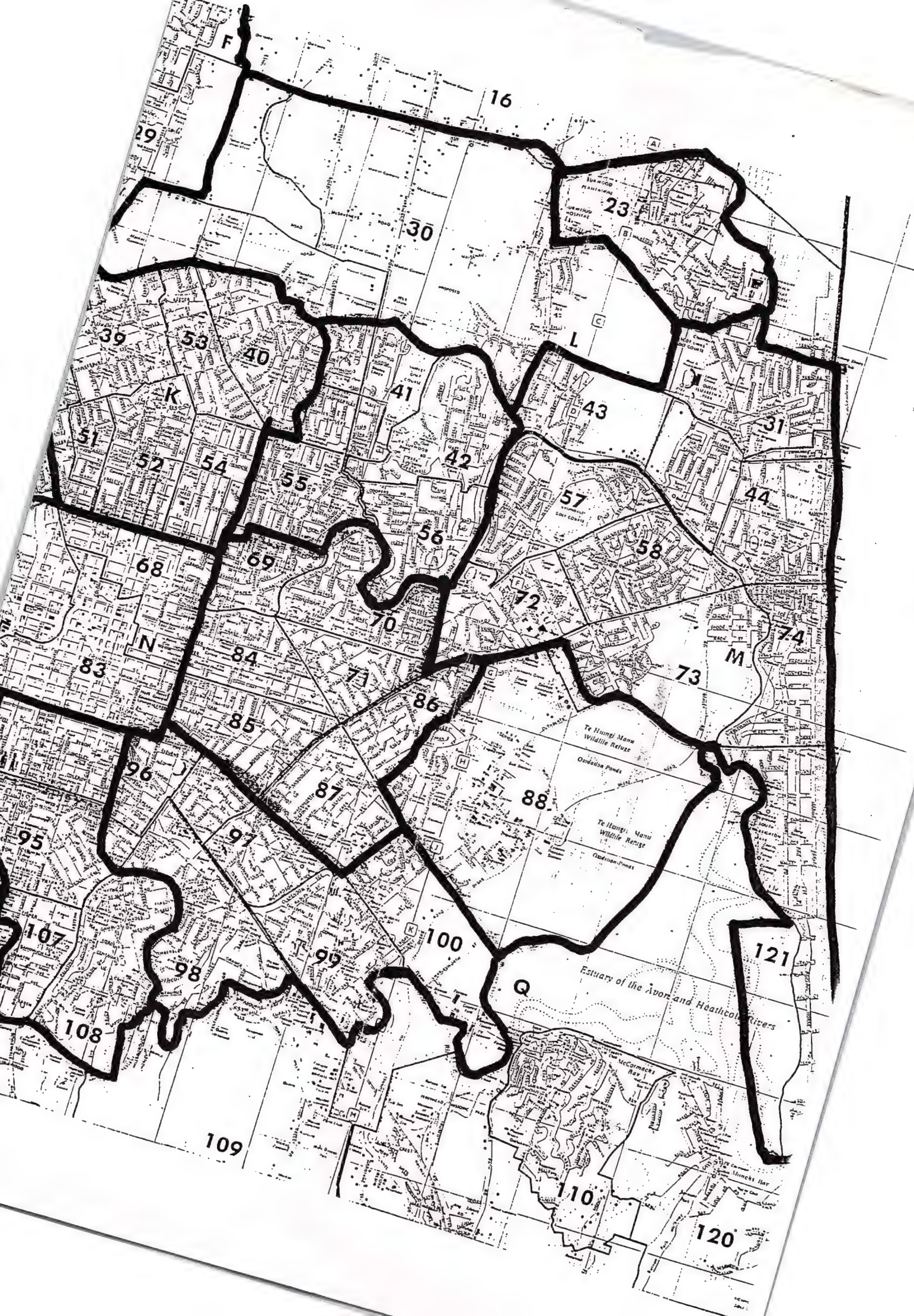
Appendices

I Suburb Boundaries
II Survey Questionnaires
III Individual Suburb Results
IV Industry Definitions
V Process Emission Factors
VI Aircraft Emissions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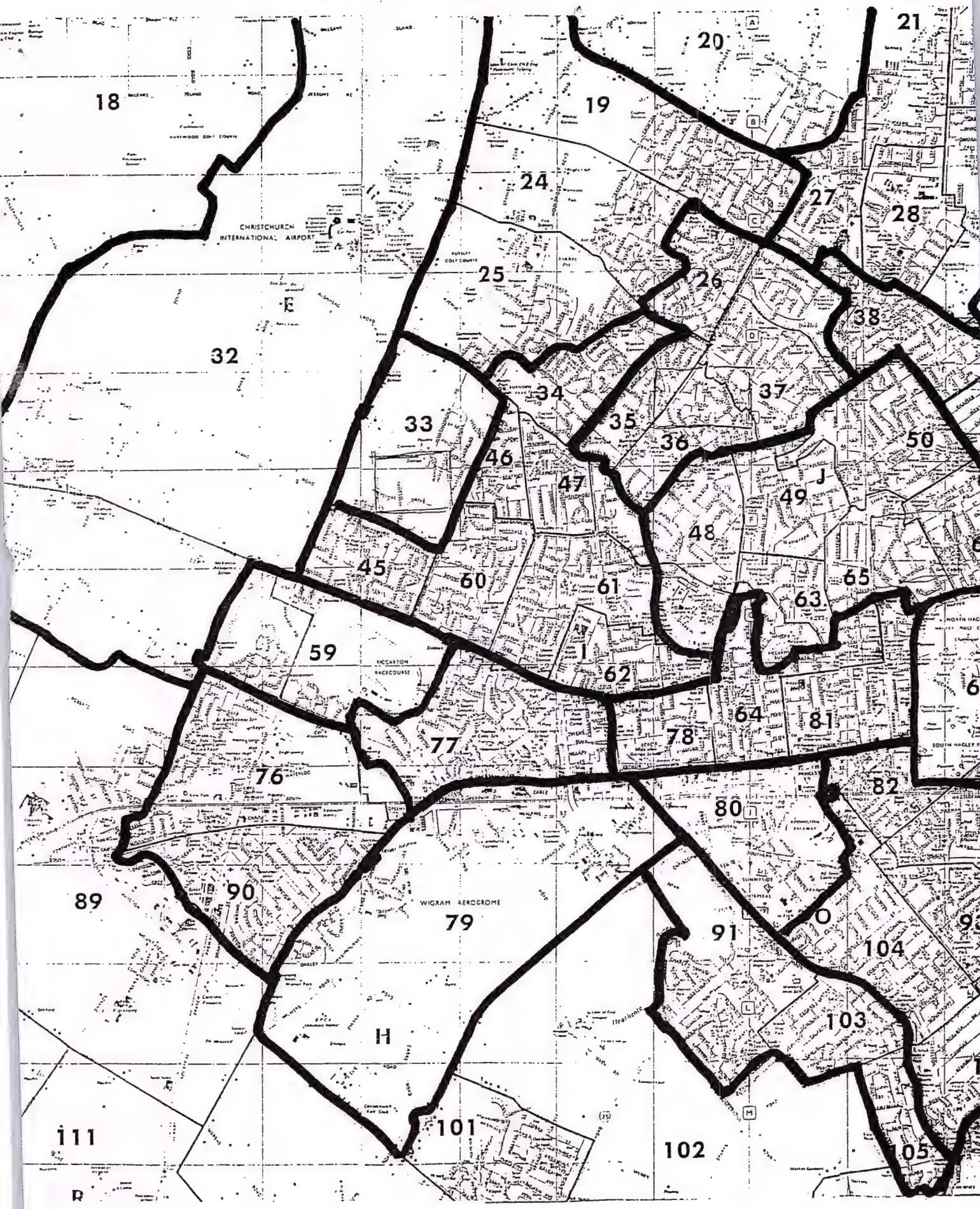
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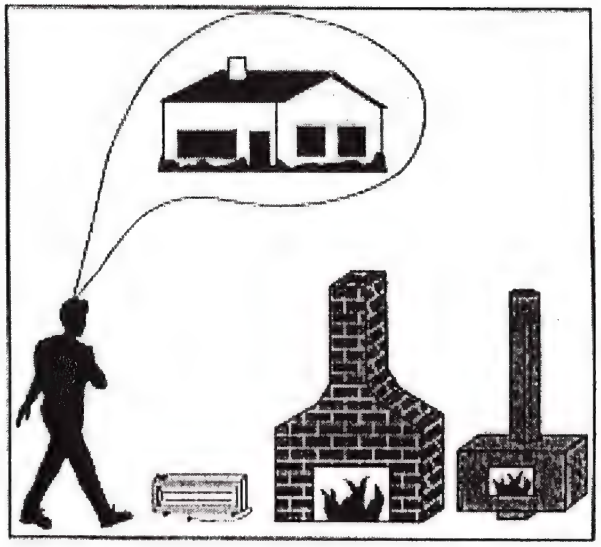
Appendix I - Suburb Boundaries

Suburb Name	Suburb Number
Inner Suburb Study Area	
Beckenham / Sydenham	95, 107, 108
Fendalton	48, 49, 50, 63, 65, 67
Inner City	66, 68, 83
Linwood	69, 70, 71, 84, 85, 86, 87
Opawa / Woolston	96, 97, 98, 99, 100
Riccarton	64, 78, 81
Shirley	41, 42, 55, 56
Spreydon / Addington	82, 92, 93, 94, 104, 106
St Albans	38, 39, 40, 51, 52, 53, 54
Outer Suburbs	
Addington Industrial	80
Airport	32
Avonhead	34, 45, 46, 47, 60, 61, 62
Bishopdale	19, 24, 25
Bromley	88
Burnside / Bryndwr	26, 35, 36, 37
Hoon Hay	91, 103, 105
Hornby	76, 90
Marshlands	30
New Avonhead	33
New Brighton	31, 43, 44, 57, 58, 72, 73, 74, 121
Parklands	23
Racecourse	59
Redwood	21, 22, 27, 28, 29
Sockburn	77
Wigram	79

Appendix II - Survey Questionnaires

Christchurch Home Heating Survey
June 1995



CANTERBURY REGIONAL COUNCIL

Christchurch Home Heating Survey
June 1995

This pilot survey on home heating methods in use in Christchurch has been designed by the Canterbury Regional Council and is being conducted by university students employed by the Council. It is designed to assist the Council to better identify domestic home heating requirements and assess the most appropriate options for the future management of air quality in Christchurch. More than five hundred questionnaires have been delivered by university students in six different areas of Christchurch City.

The main purpose of the survey is to collect reliable information on methods of home heating, the types and quantities of fuel burnt by householders, and the type of appliance used. Please try to answer all questions, even if it is only an estimate. If in doubt, use answers which best describe your average use over the last year, or on a typical winters night. Sources of information will be treated with strictest confidence.

A collector will call for the completed survey in approximately 7 days time during the early evening. If you have any questions about the survey or need help to fill in your answers, you can discuss them with the collector.

The results from the study will appear in your community newspaper once they are available, so we'll keep you posted on our progress.

Thank You For Your Help.

Home Heating Survey

SECTION A. HEATING REQUIREMENTS

Q1 Type of dwelling? *(please tick)*
☐ Stand alone house/Townhouse ☐ Apartment

Q2. Separate living rooms __ *(number)* Bedrooms __ (number)

Q3. Do you own or rent the dwelling? *(please tick)*
☐ Rented ☐ Privately owned

Q4. How old is the dwelling? *(please tick)*
☐ 10 yrs or less
☐ 11-20 yrs
☐ 21-40 yrs
☐ 40 yrs more than
☐ age unknown

Q5. Is the dwelling insulated. *(please tick)*

Yes	No	Don't Know
☐	☐	☐

Q6. If insulated, please indicate extent. *(please tick)*

	Yes	No	Don't Know
Ceiling	☐	☐	☐
Walls	☐	☐	☐
Under floor	☐	☐	☐
Double glazing	☐	☐	☐

Q7 Would you describe your dwelling as: *(please tick)*

Very drafty	☐	
Moderately drafty		☐
Slightly drafty	☐	
Draft proof	☐	

Q8 How many people live at your address? __

Q9 What age group do these people fit into?

Age group	Number of people per age group
less than 10 yrs	__
11 to 20 yrs	__
21 to 35 yrs	__
36 to 50 yrs	__
51 to 65 yrs	__
over 65 yrs	__

Q10 Main method of winter heating: *(please tick)*

	Electric	Gas	Wood fire	Coal fire	Oil	None
Main living area	☐	☐	☐	☐	☐	☐
Other living areas (if any)	☐	☐	☐	☐	☐	☐
Main living area	☐	☐	☐	☐	☐	☐
Main living area	☐	☐	☐	☐	☐	☐

If other, please specify: _____

SECTION B. ELECTRICITY USE

If electricity is not your main source of winter heating, please proceed to SECTION C.

Q11 If electricity is your main source of winter heating, do you usually use it to heat: *(please tick)*

	YES	No
Main living area	☐	☐
Other living areas (if any)	☐	☐
Bedrooms	☐	☐
Whole house	☐	☐

Q12 If you use alternative or supplementary heating to electricity at any time, do you use: *(please tick)*

Gas	☐
Wood fire	☐
Coal fire	☐
Oil fire	☐
Solar panels	☐

SECTION C. GAS HEATING

If gas is not your main source of winter heating, please proceed to SECTION D.

Q13 If electricity is your main source of winter heating, do you usually use it to heat: *(please tick)*

	YES	NO
Main living area	☐	☐
Other living areas (if any)	☐	☐
Bedrooms	☐	☐
Whole house	☐	☐

Q14 If you use alternative or supplementary heating to gas at any time, do you use: *(please tick)*

Electricity	☐
Wood fire	☐
Coal fire	☐
Oil fire	☐
Solar panels	☐

Q15 Approximately how much gas do you use during a winter? ___kg or $____

SECTION D. OIL HEATING

If an oil fired heating system is not your main source of winter heating, please proceed to SECTION E.

Q16 If an oil fired heating system is your main source of winter heating, do you usually use it to heat: *(please tick)*

	YES	No
Main living area	☐	☐
Other living areas (if any)	☐	☐
Bedrooms	☐	☐
Whole house	☐	☐

Q17 Approximately how much oil do you use during a winter? ___kg or $____

SECTION E. WOOD OR COAL HEATING

(includes open fires, woodburners, coal ranges, incinerators, pot bellies etc)

#Note. Please answer even if wood/coal heating is not your main method of home heating.

Q18 What type of wood or coal burning appliances do you have in your dwelling?

	Tick	Number of appliances
Open fire(s)	☐	___
Woodburner(s)	☐	___
Coal Range	☐	___
Incinerator	☐	___
Pot Belly	☐	___

Other *(please specify)* _____

Q19 If you use a wood or coal burner, do you usually use it to heat: *(please tick)*

	YES	NO
Main living area	☐	☐
Other living areas (if any)	☐	☐
Bedrooms	☐	☐
Whole house	☐	☐
Hot water	☐	☐

Q20 If you use alternative or supplementary heating to wood or coal burning for different areas of the dwelling during the winter, do you use: *(please tick)*

	Electricity	Gas	Oil	Solar
Main living area	☐	☐	☐	☐
Other living areas (if any)	☐	☐	☐	☐
Bedrooms	☐	☐	☐	☐
Whole house	☐	☐	☐	☐
Hot water	☐	☐	☐	☐

Q21 How many days per week do you use your main wood or coal burning appliance during winter? *(please tick)*

	7 days	5-6 days	3-4 days	1-2 days	Never
Open fire	☐	☐	☐	☐	☐
Woodburner	☐	☐	☐	☐	☐
Coal range	☐	☐	☐	☐	☐
Incinerator	☐	☐	☐	☐	☐
Pot Belly	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

Q22 If you have a second open fire or wood/coal burner, how many days per week is it used during the winter? *(please tick)*

	7 days	5-6 days	3-4 days	1-2 days	Never
Open fire	☐	☐	☐	☐	☐
Woodburner	☐	☐	☐	☐	☐

Q23 When in use, what time of the day is the wood/coal burning appliance used? *(please tick)*

	All day	Evenings only	Overnight	Mornings
Main appliance	☐	☐	☐	☐
Second appliance (if any)	☐	☐	☐	☐

Q24 Is your wood/coal burner used at any other times of the year? *(please tick)*

	YES	NO
Main appliance	☐	☐
Second appliance (if any)	☐	☐

If yes, please specify _____

Q25 Approximately how much fuel would you burn on a typical winter's night when you are using your wood or coal fire?

Logs or split logs ____ pieces
Slab wood ____ pieces
Coal ____ buckets
Other solid fuels *(please specify)* _____

Q26 Approximately how much wood, coal, or other fuel would you use per year?

Wood ___cords, or ___cubic metres, or ___ bags, or ___ trailer loads
Coal ___sacks, or ___ paper bags, or ___ tonnes, or ___ trailer loads
Other solid fuel (eg timber or chipboard offcut, tree prunnings, etc)
Please specify type and quantity:_____

Q27 What type of wood do you usually burn? *(please tick)*

Pine ☐ Blue gum ☐ Macrocarpa ☐ Manuka ☐ Willow ☐

Q28 How adequate is the heat output from your wood or coal burning appliance for the area it was installed to heat? *(please tick)*

	Main Appliance	Second Appliance	Other Appliances
Just right	☐	☐	☐
Too hot	☐	☐	☐
Not adequate	☐	☐	☐

Q29 If you have a woodburner, please indicate the following (most information should be contained on the label):

Name: _____ Model: _____ Heat Output ___

Approximate year of installation: (please tick)

More that 10 years ago (before 1985)	☐
1985-1989	☐
1990-1993	☐
Since 1993	☐

SECTION F. CHOICE OF HOME HEATING AND GENERAL COMMENT

Q30 What are the main factors which influence your choice of home heating methods: *(please tick as many as you feel important)*

Cost	☐
Convenience	☐
Comfort	☐
Appearance	☐
Effective heating	☐
Risk of power cuts	☐
Access to cheap fuel	☐
Concern about air pollution	☐

Other (please specify) _____

_____

_____

Q31 Any general comments about home heating that you would like to add:

_____

_____

_____

_____

_____

Thank You For Your Time In Completing This Questionnaire

If for any reason you miss or collector, please post this survey back to the Canterbury Regional Council at the address shown below.

"Home Heating Survey"
Canterbury Regional Council
58 Kilmore Street
PO Box 345
Christchurch.

30 October 1995 Code: 4157/LD

HOME HEATING SURVEY

Introduction: Good morning/afternoon/evening. My name is ..... from MRL Research Group. We are conducting a very brief survey on behalf of the Canterbury Regional Council to assess home heating needs in Christchurch.

Could I please speak to the person who owns or is responsible for renting this house?

(If necessary say: the survey will honestly only take 5 minutes)

Is now a convenient time, or can I make an appointment to call back later?

Appointment call back: Time:_____

Date: _____

Respondent's first name:_____

S1 To ensure we have a representative spread of streets and suburbs throughout Christchurch can I please ask which street and suburb you live in?

Suburb_____Street_____
(Check suburb quota, if not in quota close with thanks.)

Q1. Which of the following energy sources do you normally use to heat your main living area in winter (Read out) CODE IN COLUMN Q1 BELOW.

		Q1	Q2
	Electricity	01#	
	Natural Gas	02	
	LPG	03	
	Coal	04*	
	Wood	05*	
	Solar	06	
	Oil Heater - oil run	07	
	Oil Heater - electrical	08	
	Some other method (state)	98	
Don't read	Don't know	99	
			100%

CHECK PERCENTAGE ADDS TO 100

IF MORE THAN ONE METHOD USED ASK Q2 O OTHERWISE GO TO Q3

Q2. You said you use ..... (all methods used). Approximately what percentage or the time would you use ..... (Read out each method used). WRITE IN PERCENTAGES (2 DIGITS) IN COLUMN "Q2" above).

CHECK BACK TO Q1. IF WOOD (05*) OR COAL (04') CODED ASK Q3 OTHERWISE GO TO Q4

Q3. You mentioned that you burnt wood/coal to heat your main living area. Is this on a ..... READ OUT. CODE ALL THAT APPLY IN APPROPRIATE COLUMN BELOW.

	Wood	Coal
Open fire/visor	1	1
Woodburner	2	2
Juno/Coal Range/Coal Burner	3	3
Pot Belly	4	4

Other (Please specify) 8 8

_____

_____

Don't read Don't know 9 9

CHECK BACK TO Q1/Q2. IF ELECTRICITY, (CODE 01#) IS NOT USED AS THE ONLY OR MAIN SOURCE OF HEATING IN THE MAIN LIVING AREA ASK Q4 OTHERWISE ASK Q5.

FOR ALL FORMS OF HEATING CODED AT Q3 ASK Q4, AND FOR ANY OF CODES 02, 03 OR 07 CIRCLED AT Q3 ASK Q4

Q4. How many of the following heating appliances do you normally use to heat your <u>main living area</u> in winter?

Open fire/visor ..... _____
Woodburner ..... _____
Juno/Coal Range/Coal Burner ..... _____
Pot Belly ..... _____
Non electric oil heater ..... _____
Gas heater ..... _____
Other (State) ..... _____
_____ _____

CHECK BACK TO Q1. IF WOOD CODED (05) ASK Q5 AND Q6 OTHERWISE ⇒ Q7

Q5. On the days when you use wood to heat your main living area in winter, how much wood do you <u>normally</u> burn per day (excluding kindling)? (Probe for detail)

If necessary: prompt for - number of logs/pieces?
- kilograms?

_____

_____

_____

Don't know 9

Q6. Where do you <u>normally</u> get your wood supply from? (Code <u>one</u> only)

Wood merchant.....01
Other (Please state.....02

_____

_____

Don't know 99

CHECK BACK TO Q1, IF <u>COAL</u> CODED (04) ASK Q7, OTHERWISE ⇒ Q8
Q7. On the days when you burn coal to heat your main living area in winter, how much coal do you normally burn (per day). (Probe for detail)

If necessary: prompt for - number of buckets?
- number of bags?
- kilograms?

_____

_____

_____

Don't know 9

CHECK BACK TO Q1, IF EVER HEAT MAIN LIVING AREA USING WOOD AND/OR COAL (CODES 04, 05) ASK Q8 OTHERWISE GO TO Q9.

Q8. Which of the following times do you normally heat your main living area using wood/coal in winter? Read out. Code all that apply.

Morning (sometime during 6arn-10am) 1
Day time (sometime during 10am-4pm) 2
Evening (sometime during 4pm-1Opm) 3
Over night (sometime during lOpm-6am) 4

Don't know 9

CHECK BACK TO Q1, IF EVER HEAT MAIN LIVING AREA BY USING ANYTHING OTHER THAN WOOD OR COAL ASK Q9. OTHERWISE GO TO Q10

Q9. Which of the following times do you normally heat your main living area in winter using/either electricity/gas/LPG/oil heater/or "other" (methods coded at Q1)?
Read out. Code all that apply.

Morning (sometime during 6arn-10am) 1
Day time (sometime during 10am-4pm) 2
Evening (sometime during 4pm-1Opm) 3
Over night (sometime during lOpm-6am) 4

Don't know 9

Q10. Approximately how old is the house or dwelling that you are presently living in?

Over one hundred years old (built 1890's or earlier).....01
Approximately 50-100 years old (built 1890's-1940's) 02
Approximately 40 years old (built 1950's).....03
Approximately 30 years old (built 1960's).....04
Approximately 20 years old (built 1970's).....05
Approximately 10 years old (built 1980-1985) 06
Approximately 5-9 years old (built 1986-1990) 07
Approximately 3-4 years old (built 1991-1992) 08
Approximately 1-2 years old (built 1983-1994) 09
Less than 1 year old (built 1995).....10

Don't know 99

Q11. Could I please record your first name. We ask this because our supervisor checks a percentage of the surveys for quality control - it is not to identify you with the data. (Record first name only)

_____

Record telephone Number:_____Date:_____

Thank you very much for participating in this survey. Should you have any queries regarding this interview my name is ..... from MRL Research Group. My field manager is ..... (give phone number if requested .....).

"I hereby certify that this is a true and accurate record of the survey carried out by me according to instructions."

INTERVIEWER'S NAME:_____PHONE:_____

INTERVIEWER NUMBER:_____DATE:_____

Telephone Home Heating - Domestic Wintertime Emissions To Air Questionnaire

Questionnaire Code _____

Introduction:

Good morning/afternoon/evening. My name is (.....) and I am from (.....). We are conducting a very brief survey on behalf of the (.....) to assess home heating needs.

Could I please speak to the person who owns or is responsible for your house?

Is now a convenient time, or can I make an appointment to call back later?

Appointment Call Back: Time:_____

Date:_____

Respondent's first name:_____

To ensure we have a representative spread of streets and suburbs throughout (.....) can I please ask which **street** and **suburb** you live in?

Suburb_____ (Check suburb quota, if not in quota

Street_____close with thanks)

Q1. How old is the dwelling?

10yrs or less	☐
11-20yrs	☐
21-40yrs	☐
40yrs or more	☐
age unknown	☐

Q2. What percentage of time do you usually use the following energy sources to heat your main living area in winter? **(read out)**

Electricity (including oil column heaters)	_____
Gas (including LPG)	_____
Coal	_____
Wood	_____
Oil fire	_____
Solar	_____
	100% (Check percentages add to 100%)

- If wood and/or coal are used as home heating energy sources (Q2.), then ask Q3., otherwise proceed to Q4.
- If electricity is not listed in Q2. as 100% then ask Q4, otherwise proceed to Q11.

Q3. You mentioned that you burnt wood and/or coal to heat your main living area. Is this on a .....? **(read out and tick appropriate box or boxes)**

	Wood	Coal
Open fire/Visor	☐	☐
Woodburner	☐	☐
Juno/Coal Range	☐	☐
Pot Belly	☐	☐
Incinerator	☐	☐

Q4. How many of the following appliances do you normally use to heat your main living area on a typical winters day?

Open fire/Visor	_____
Woodburner	_____
Juno/Coal Range	_____
Pot Belly	_____
Incinerator	_____
Non electric oil heater	_____
Gas heater	_____

- Check Q2. to see if wood is used as a home heating energy source. If it is ask Q5., otherwise proceed to Q6.

Q5. You mentioned that you use a woodburner to heat your main living area. What year was it installed?

Before 1985	☐
1985 - 1989	☐
1990 - 1993	☐
Since 1993	☐
Date unknown	☐

Q6. On the days when you use wood to heat your main living area in winter, please estimate how much wood you normally burn per day excluding kindling? **(probe for detail)**

Split logs	_____number of logs
Sawmill offcuts	_____number of pieces
Timber offcuts	_____number of pieces
Wood	_____kilograms

- Check Q2. to see if coal is used as a home heating energy source. If it is ask Q7., otherwise proceed to Q8.

Q7. On the days when you use coal to heat your main living area in winter, please estimate how much coal you normally burn per day? **(probe for detail)**

Buckets	_____number of buckets
Bags	_____number of bags _____weight of bag (kg)
Coal	_____kilograms

What type of coal do you use? _____

- Check Q2. to see if gas is used as a home heating energy source. If it is ask Q8., otherwise proceed to Q9.

Q8. Please estimate how much gas you use per week to heat your main living area in winter. **(probe for detail)**

Gas	_____kilograms
Gas	_____dollars

- Check Q2. to see if oil is used as a home heating energy source. If it is ask Q9., otherwise proceed to Q10.

Q9. Please estimate how much oil you use per week to heat your main living area in winter. **(probe for detail)**

Oil	_____litres
Oil	_____dollars

- Check Q2., if wood and/or coal is used to heat the main living area ask Q10., otherwise proceed to Q11.

Q10. Which of the following times do you normally heat your main living area in winter using wood/coal? **(read out)**

Monday to Friday

Morning (sometime between 6am - 10am)	☐
Day time (sometime between 10am - 4pm)	☐
Evening (sometime between 4pm - 10pm)	☐
Over night (sometime during 10pm - 6am)	☐

Saturday and Sunday

Morning (sometime between 6am - 10am)	☐
Day time (sometime between 10am - 4pm)	☐
Evening (sometime between 4pm - 10pm)	☐
Over night (sometime during 10pm - 6am)	☐

- Check Q2., if other energy sources are ever used to heat the main living area in winter ask Q11., otherwise proceed to Q12.

Q11. Which of the following times do you normally heat your main living area in winter using electricity/gas/oil/ other? **(read out)**

Monday to Friday

Morning (sometime between 6am - 10am)	☐
Day time (sometime between 10am - 4pm)	☐
Evening (sometime between 4pm - 10pm)	☐
Over night (sometime during 10pm - 6am)	☐

Saturday and Sunday

Morning (sometime between 6am - 10am)	☐
Day time (sometime between 10am - 4pm)	☐
Evening (sometime between 4pm - 10pm)	☐
Over night (sometime during 10pm - 6am)	☐

Q12. How many people live at your address? _____

What age group do these people fit into?

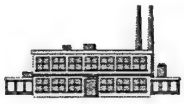
Age Group	**No. of People per Age Group**
10yrs or less	___
11-20yrs	___
21-35yrs	___
36-50yrs	___
51-65yrs	___
66yrs or more	___

Q13. Could we please record your first name and telephone number so that we may contact you if our supervisor requires clarification regarding your replies to this survey?

First name _____ Telephone number_____

Surveyor_____ Today's date_____

Christchurch Emissions Inventory - Industrial Questionnaire



Questionnaire Code _____

Company Name _____

CRC Permit No (if known):_____

Plant Address:_____

Suburb _____

Postal Address _____

Suburb _____ City _____

Person completing Questionnaire _____

Contact Phone No. _____ Fax No. _____

Q1. Nature of business: _____

_____

_____

e.g. textile printing, fertiliser production, metal foundry, etc.
Attach a simple process flow diagram if available.

Operating Schedule

Q2. Months of the year: ***(cross out month(s) <u>not</u> operating)***

JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

Q3. Days of the week**:** ***(cross out day(s) <u>not</u> operating)***

MON TUE WED THU FRI SAT SUN

Q4. Hours of the day: ***(cross out hour(s) <u>not</u> operating)***

am	1	2	3	4	5	6	7	8	9	10	11	12(noon)
pm	1	2	3	4	5	6	7	8	9	10	11	12(midnight)

Q5. Seasonal variation:

If production varies throughout the year for any reason please indicate the approximate production as a percentage of a full year, for the four periods below.
e.g. Jan-Mar 30%, Apr-Jun 20%, Jul-Sep 10%, Oct-Dec 40%

JAN - MAR	APR - JUN	JUL - SEP	OCT - DEC

Major Materials

Q6. Please estimate the annual consumption of major raw materials *(tonnes/year, litre/year, kilogram/year, etc.)*

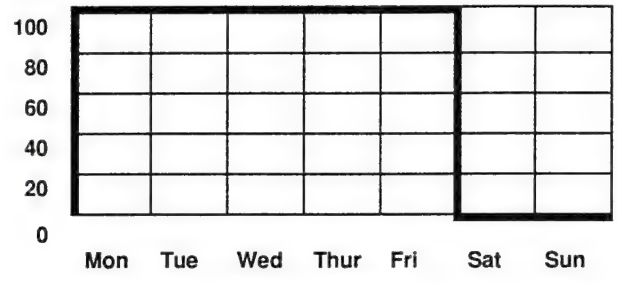
Raw Materials Consumed	Annual Quantity
1.	
2.	
3.	
4.	
5.	
6.	
7.	

Q7. Please estimate the annual production of major manufactured products *(tonnes/year, litre/year, kilogram/year, etc.)*

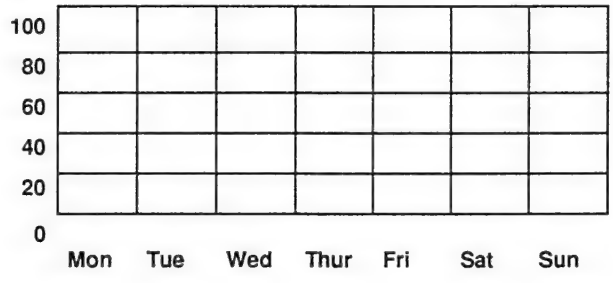
Manufactured Products	Annual Quantity
1.	
2.	
3.	
4.	
5.	
6.	
7.	

Fuel Combustion Emissions

Q8. Estimate the percentage of fuel combustion throughout the **week**. The example shown indicates a constant use Monday to Friday with no weekend usage.

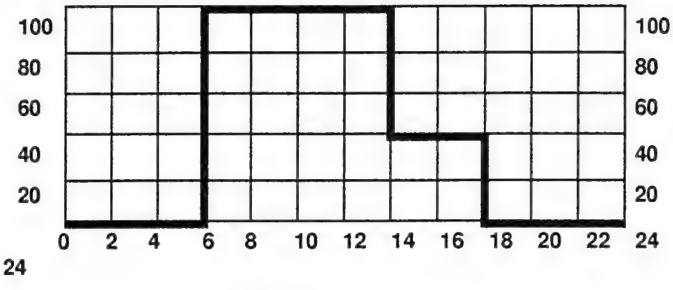


EXAMPLE

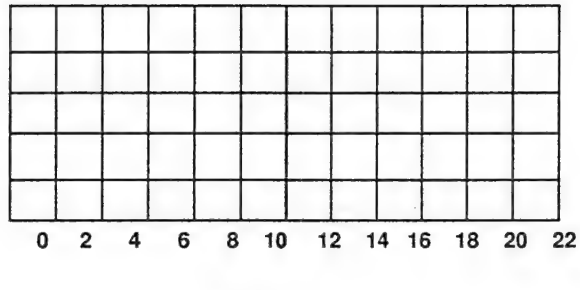


ACTUAL

Q9. Estimate the percentage of fuel combustion throughout the **day** *(please note the use of a 24 hour clock)*. The example shown indicates a constant use of full power and then at 40% from 2pm to 6pm.



EXAMPLE



ACTUAL

Stack Emissions

Q10. If emissions to the air from your stack are known or can be estimated, please list below. If unknown, please write "unknown".

Stack number & Height[a] (in m)	Compounds discharged[b]	Discharge rate[c] (if known)	Type of emission control[d]
1.			
2.			
3.			
4.			
5.			
6.			
7.			

a) height above ground in metres
b) CO, particulates (PM10 if known), NOx, VOCs (specify compounds if known), SOx, and CO_2
c) mass/unit time e.g. kg/hr, tonne/year
d) e.g. baghouse, electrostatic precipitator, scrubber etc.

Storage Tank Losses

Q11. Storage tanks containing volatile organic compounds (VOCs)
(e.g. fuel oil, diesel, petrol, CNG, paint thinners, solvents etc.)

Tank No.	Tank type		Capacity (kilolitres)	Yearly tank throughput (kilolitres)	Fuels, solvents or gases stored	Process where solvent is used[a]	Estimated annual losses (kg or litres)
	above ground	below ground					

a) e.g. vehicle refuelling, metal degreasing, spray painting etc.

Waste Combustion

Q12. Please estimate the amount of waste burnt at the premises for each quarter.

Type of material[a] incinerated	Amount incinerated (tonnes/season or kg/season)				Type of incinerator[b] used	Operating hours	Days per year
	JAN-MAR	APR-JUN	JUL-SEP	OCT-DEC			

a) e.g. wood, paper, rubber, car tyres, 'off-spec' product (please specify)
b) e.g. multiple chamber, single chamber, trench, flue fed single chamber, 'domestic single chamber, etc.

Surface Coating Operations

Q13. Please estimate annual consumption of paints, lacquers and solvents used for surface coating. *(attach separate list if necessary)*

Coating type[a]	Coating product name	Percentage volatile organics (if known)	Annual consumption (in L)	Type of emission control[b]	Percentage[b] control efficiency

a) Solvent based, water based, thinners (supply type of thinners)
b) If control of volatile vapour is employed

Fugitive Emissions - valves, seals and flanges

Q14. Please estimate the annual losses from valves, seals, and flanges *(specify compounds if known).*

Fugitive Losses - open air processing

This can include a wide range of processes not covered elsewhere in this questionnaire e.g. painting, wastewater treatment, fuel transfer operations etc.

Q15. Please estimate the annual losses from open air processing *(specify compounds if known)*

Other Emissions and Processes

Any emissions from processes which have nor been considered elsewhere.

Q16. Special processes, describe the process and estimate annual emissions

Q17. Comments

Appendix III - Individual Suburb Results

Addington Industrial

	Daily Fuel Quantity			PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg/day	t/day	Use %	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Open fire																					
- Wood	489	0.5	37	7	32	17	59	256	36	1	4	29	0	0	1	15	64	36	832	3624	18
- Coal	369	0.4	42	12	53	29	22	96	14	1	2	20	7	29	41	6	24	14	1032	4496	22
Pre 1989 Woodburner																					
- Wood	143	0.1	11	2	8	4	15	64	9	0	1	7	0	0	0	4	16	9	244	1061	5
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989-1992 (incl) Woodburner																					
- Wood	358	0.4	27	2	11	6	20	86	12	0	1	10	0	0	0	5	22	12	609	2653	13
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post 1993 Woodburner																					
- Wood	287	0.3	22	2	7	4	14	59	8	0	1	7	0	0	0	3	15	8	487	2123	10
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enclosed Coal Burner																					
- Wood	44	0.0	3	1	3	1	5	22	3	0	0	2	0	0	0	1	5	3	74	324	2
- Coal	519	0.5	58	16	71	38	30	129	18	1	3	26	9	41	58	7	32	18	1452	6328	31
Pot Belly																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incinerator																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Wood	1321	1.3		14	61	33	112	487	68	2	7	54	0	1	2	28	122	68	2246	9784	47
Total Coal	887	0.9		28	124	67	52	226	32	1	6	46	16	70	98	13	56	32	2484	10825	53
Total Gas	66	0.1		0	0		0	0		0	1		0	0		0	0		165	718	
Total Oil	60	0.1		0	0		0	0		0	1		0	1		0	0		192	837	
Total (Wood and Coal only)	2208	2		42	185	100	163	712	100	3	12	100	16	71	100	41	178	100	4730	20609	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Light duty <3.5t petrol vehicles	7	31	29	2216	9655	90	198	864	49	1	4	5	454	1978	83	34296	149438	69
Light duty <3.5t diesel vehicles	1	3	3	4	19	0	3	12	1	1	5	5	2	9	0	2046	8916	4
Light duty <3.5t LPG/CNG vehicles	0	0	0	5	21	0	6	26	1	0	0	0	6	26	1	977	4257	2
Heavy duty >3.5t petrol vehicles	1	3	3	140	609	6	9	39	2	0	0	0	14	61	3	1697	7394	3
Heavy duty >3.5t diesel vehicles	16	69	64	74	321	3	184	801	46	18	77	87	59	256	11	10480	45666	21
Heavy duty >3.5t LPG/CNG vehicles	0	0	0	5	21	0	1	6	0	0	0	0	2	11	0	242	1054	0
2&4 stroke petrol motorcycles	0	0	0	16	72	1	0	1	0	1	2	3	7	32	1	81	354	0
Total	25	108	100	2460	10717	100	401	1749	100	20	88	100	544	2372	100	49819	217078	100

	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Part A																		
Combustion	0.1	0.3	7	0.1	0.6	9	0.6	2.5	11	0.8	3.6	17	0.0	0.2	1	671.9	2928.3	44
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.1	0.3	7	0.1	0.6	9	0.6	2.5	11	0.8	3.6	17	0.0	0.2	1	671.9	2928.3	44
Part B																		
Combustion	0.1	0.3	8	0.2	0.7	11	0.7	3.2	14	1.0	4.6	21	0.0	0.2	1	844.2	3679.1	56
Other Processes	0.3	1.3	33	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.4	1.6	42	0.2	0.7	11	0.7	3.2	14	1.0	4.6	21	0.0	0.2	1	844.2	3679.1	56
Part C																		
Combustion	0.5	2.0	52	1.3	5.5	81	3.9	16.9	75	3.0	13.1	61	0.2	1.0	4	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	5.2	22.7	94	0.0	0.0	0
Sub-total	0.5	2.0	52	1.3	5.5	81	3.9	16.9	75	3.0	13.1	61	5.4	23.7	98	0.0	0.0	0
Total																		
Combustion	0.6	2.5	67	1.6	6.8	100	5.2	22.7	100	4.9	21.3	100	0.3	1.4	6	1516.1	6607.4	100
Other Processes	0.3	1.3	33	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	5.2	22.7	94	0.0	0.0	0
Total	0.9	3.8	100	1.6	6.8	100	5.2	22.7	100	4.9	21.3	100	5.5	24.1	100	1516.1	6607.4	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	3	13	4	9	40	0	0	1	0	1	6	3	2	10	0	317	1381	1
10am-4pm	5	22	7	18	79	1	0	1	0	2	9	5	5	20	1	617	2690	1
4pm-10pm	28	123	42	118	514	4	2	9	0	10	43	24	29	128	5	3162	13776	5
10pm-6am	6	26	9	18	79	1	0	2	0	3	12	7	5	20	1	634	2762	1
Total	42	185	62	163	712	6	3	12	1	16	71	39	41	178	7	4730	20609	8
Motor Vehicles																		
6am-10am	5	24	8	542	2357	21	88	385	22	4	19	11	120	522	20	10979	47736	18
10am-4pm	11	50	17	1135	4937	43	185	806	45	9	41	23	251	1093	42	23000	99999	38
4pm-10pm	7	29	10	664	2888	25	108	471	26	5	24	13	147	639	25	13452	58489	22
10pm-6am	1	5	2	118	513	4	19	84	5	1	4	2	26	113	4	2388	10383	4
Total	25	108	36	2460	10694	93	401	1745	98	20	88	49	544	2367	92	49819	216606	82
Industry																		
6am-10am	0	1	0	0	2	0	1	6	0	1	5	3	1	6	0	1515	6603	3
10am-4pm	1	2	1	1	4	0	3	14	1	3	13	7	3	15	1	3768	16423	6
4pm-10pm	0	0	0	0	1	0	1	3	0	1	3	1	1	3	0	739	3223	1
10pm-6am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1	4	1	2	7	0	5	23	1	5	21	12	6	24	1	6023	26249	10
Combined Total																		
6am-10am	9	38	13	552	2404	21	90	392	22	7	31	17	124	539	21	12811	55833	21
10am-4pm	17	74	25	1155	5032	44	189	823	46	15	63	35	259	1130	44	27386	119350	45
4pm-10pm	35	153	52	782	3409	30	111	484	27	16	70	39	177	772	30	17354	75629	29
10pm-6am	7	31	11	136	593	5	20	85	5	4	16	9	31	134	5	3022	13170	5
Total	68	297	100	2625	11438	100	409	1785	100	41	180	100	591	2575	100	60572	263982	100

Airport

	Daily Fuel Quantity			PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg/day	t/day	Use %	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Open fire																					
- Wood	55	0.1	11	1	0	6	7	3	12	0	0	10	0	0	0	2	1	12	94	45	6
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pre 1989 Woodburner																					
- Wood	147	0.1	29	2	1	15	15	7	26	0	0	22	0	0	1	4	2	26	250	120	16
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989-1992 (incl) Woodburner																					
- Wood	49	0.0	10	0	0	3	3	1	5	0	0	4	0	0	0	1	0	5	83	40	5
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post 1993 Woodburner																					
- Wood	147	0.1	29	1	0	7	7	3	12	0	0	10	0	0	1	2	1	12	250	120	16
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enclosed Coal Burner																					
- Wood	68	0.1	13	1	0	8	8	4	14	0	0	11	0	0	0	2	1	14	116	55	8
- Coal	198	0.2	83	6	3	48	11	5	20	0	0	30	4	2	81	3	1	20	554	266	36
Pot Belly																					
- Wood	38	0.0	8	1	0	4	4	2	8	0	0	6	0	0	0	1	1	8	65	31	4
- Coal	40	0.0	17	1	1	10	2	1	4	0	0	6	1	0	16	1	0	4	111	53	7
Incinerator																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Wood	505	0.5		5	3	42	44	21	76	1	0	64	0	0	2	11	5	76	858	411	56
Total Coal	238	0.2		7	4	58	14	7	24	0	0	36	4	2	98	3	2	24	665	319	44
Total Gas	23	0.0		0	0		0	0		0	0		0	0		0	0		57	27	
Total Oil	14	0.0		0	0		0	0		0	0		0	0		0	0		46	22	
Total (Wood and Coal only)	743	1		13	6	100	57	27	100	1	0	100	4	2	100	14	7	100	1524	730	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Light duty <3.5t petrol vehicles	9	4	23	1819	872	85	453	217	50	1	1	3	516	247	84	61505	29462	69
Light duty <3.5t diesel vehicles	1	1	3	8	4	0	5	2	1	2	1	5	4	2	1	3669	1758	4
Light duty <3.5t LPG/CNG vehicles	0	0	0	5	2	0	11	5	1	0	0	0	10	5	2	1752	839	2
Heavy duty >3.5t petrol vehicles	2	1	4	197	94	9	27	13	3	0	0	0	20	9	3	3043	1458	3
Heavy duty >3.5t diesel vehicles	27	13	69	63	30	3	411	197	45	30	15	88	51	24	8	18795	9003	21
Heavy duty >3.5t LPG/CNG vehicles	0	0	0	8	4	0	3	1	0	0	0	0	4	2	1	434	208	0
2&4 stroke petrol motorcycles	0	0	0	29	14	1	0	0	0	1	0	3	13	6	2	146	70	0
Total	40	19	100	2130	1020	100	909	436	100	34	16	100	617	296	100	89343	42797	100

	PM10			CO			NOx			SOx			VOC			CO2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Part A																		
Combustion	0.7	0.4	2	1.9	0.9	78	8.0	3.8	78	10.5	5.0	77	0.5	0.2	11	9210.0	4411.7	91
Other Processes	41.3	19.8	98	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	42.0	20.1	99	1.9	0.9	78	8.0	3.8	78	10.5	5.0	77	0.5	0.2	11	9210.0	4411.7	91
Part B																		
Combustion	0.1	0.0	0	0.2	0.1	7	0.7	0.4	7	1.1	0.5	8	0.0	0.0	1	862.1	412.9	9
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	1.3	0.6	29	0.0	0.0	0
Sub-total	0.1	0.0	0	0.2	0.1	7	0.7	0.4	7	1.1	0.5	8	1.3	0.6	30	862.1	412.9	9
Part C																		
Combustion	0.1	0.1	0	0.3	0.2	14	1.5	0.7	15	2.1	1.0	16	0.1	0.0	2	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	2.6	1.2	57	0.0	0.0	0
Sub-total	0.1	0.1	0	0.3	0.2	14	1.5	0.7	15	2.1	1.0	16	2.7	1.3	59	0.0	0.0	0
Total																		
Combustion	1.0	0.5	2	2.4	1.1	100	10.3	4.9	100	13.7	6.6	100	0.6	0.3	14	10072.1	4824.7	100
Other Processes	41.3	19.8	98	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	3.9	1.9	86	0.0	0.0	0
Total	42.2	20.2	100	2.4	1.1	100	10.3	4.9	100	13.7	6.6	100	4.5	2.2	100	10072.1	4824.7	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	1	1	1	5	3	0	0	0	0	0	0	1	1	1	0	146	70	0
10am-4pm	3	2	3	11	5	1	0	0	0	1	1	3	3	1	0	350	168	0
4pm-10pm	7	3	8	35	17	2	1	0	0	2	1	4	9	4	1	870	417	1
10pm-6am	1	1	1	6	3	0	0	0	0	0	0	1	1	1	0	157	75	0
Total	13	6	14	57	27	3	1	0	0	4	2	8	14	7	2	1524	730	1
Motor Vehicles																		
6am-10am	9	4	9	478	229	22	204	98	22	8	4	15	138	66	22	20038	9597	20
10am-4pm	17	8	18	924	443	42	394	189	43	15	7	28	268	128	42	38757	18562	38
4pm-10pm	12	6	12	620	297	28	265	127	29	10	5	19	180	86	28	26014	12459	25
10pm-6am	2	1	2	108	52	5	46	22	5	2	1	3	31	15	5	4534	2172	4
Total	40	19	42	2130	1020	97	909	435	99	34	16	66	617	296	97	89343	42789	87
Industry																		
6am-10am	11	5	11	1	0	0	2	1	0	3	2	6	1	1	0	2689	1288	3
10am-4pm	26	13	28	1	1	0	5	2	0	6	3	12	3	1	0	5240	2510	5
4pm-10pm	5	3	6	1	0	0	2	1	0	3	2	6	1	0	0	2830	1356	3
10pm-6am	0	0	0	0	0	0	1	0	0	1	0	2	0	0	0	1037	497	1
Total	42	20	45	2	1	0	10	5	1	14	7	26	5	2	1	11796	5651	11
Combined Total																		
6am-10am	21	10	22	484	232	22	206	99	22	11	5	22	141	67	22	22873	10956	22
10am-4pm	47	22	49	937	449	43	399	191	43	23	11	43	273	131	43	44347	21243	43
4pm-10pm	24	12	25	656	314	30	268	128	29	15	7	29	189	91	30	29714	14234	29
10pm-6am	3	2	4	114	55	5	47	23	5	3	2	6	33	16	5	5729	2744	6
Total	95	45	100	2190	1049	100	920	441	100	52	25	100	636	305	100	102663	49177	100

Avonhead

	Daily Fuel Quantity			PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg/day	t/day	Use %	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Open fire																					
- Wood	1758	1.8	11	26	36	6	211	290	11	3	4	9	0	0	0	53	73	11	2989	4113	6
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pre 1989 Woodburner																					
- Wood	6264	6.3	39	80	110	19	641	883	34	9	12	28	1	2	1	160	221	34	10650	14657	22
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989-1992 (incl) Woodburner																					
- Wood	1566	1.6	10	11	15	3	86	119	5	1	2	4	0	0	0	22	30	5	2662	3664	5
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post 1993 Woodburner																					
- Wood	3132	3.1	19	18	25	4	148	203	8	2	3	7	1	1	0	37	51	8	5325	7328	11
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enclosed Coal Burner																					
- Wood	2172	2.2	13	31	43	7	249	342	13	3	5	11	0	1	0	62	86	13	3693	5083	8
- Coal	6315	6.3	83	199	273	47	361	497	19	9	12	29	114	156	81	90	124	19	17682	24335	36
Pot Belly																					
- Wood	1212	1.2	8	17	24	4	139	191	7	2	3	6	0	0	0	35	48	7	2061	2837	4
- Coal	1263	1.3	17	40	55	9	72	99	4	2	2	6	23	31	16	18	25	4	3536	4867	7
Incinerator																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Wood	16106	16.1		184	254	44	1474	2029	77	20	28	65	3	4	2	368	507	77	27380	37682	56
Total Coal	7578	7.6		238	328	56	433	597	23	11	15	35	136	188	98	108	149	23	21218	29202	44
Total Gas	725	0.7		0	0		0	0		1	2		0	0		0	0		1813	2496	
Total Oil	460	0.5		1	1		0	0		1	1		2	2		0	0		1472	2026	
Total (Wood and Coal only)	23684	24		423	582	100	1907	2625	100	31	43	100	140	192	100	477	656	100	48598	66884	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Light duty <3.5t petrol vehicles	29	40	29	8871	12209	90	825	1136	49	4	6	5	1833	2522	83	140970	194014	69
Light duty <3.5t diesel vehicles	3	4	3	18	25	0	12	16	1	4	6	5	8	12	0	8411	11575	4
Light duty <3.5t LPG/CNG vehicles	0	0	0	19	27	0	25	34	1	0	0	0	24	33	1	4016	5526	2
Heavy duty >3.5t petrol vehicles	3	5	3	568	782	6	38	52	2	0	0	0	57	78	3	6975	9599	3
Heavy duty >3.5t diesel vehicles	65	90	65	295	406	3	765	1053	46	72	100	87	236	324	11	43079	59288	21
Heavy duty >3.5t LPG/CNG vehicles	0	0	0	19	27	0	6	8	0	0	0	0	10	14	0	994	1368	0
2&4 stroke petrol motorcycles	0	0	0	67	93	1	1	1	0	2	3	3	30	42	1	334	459	0
Total	101	139	100	9859	13568	100	1671	2300	100	83	114	100	2198	3025	100	204777	281830	100

	PM10			CO			NOx			SOx			VOC			CO2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Part A																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Part B																		
Combustion	129.1	177.6	95	114.6	157.6	97	141.6	194.9	91	275.4	379.1	91	6.9	9.5	96	81276.7	111854.6	100
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	129.1	177.6	95	114.6	157.6	97	141.6	194.9	91	275.4	379.1	91	6.9	9.5	96	81276.7	111854.6	100
Part C																		
Combustion	6.4	8.9	5	3.6	5.0	3	13.5	18.6	9	26.3	36.3	9	0.3	0.4	4	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	6.4	8.9	5	3.6	5.0	3	13.5	18.6	9	26.3	36.3	9	0.3	0.4	4	0.0	0.0	0
Total																		
Combustion	135.5	186.5	100	118.2	162.6	100	155.1	213.5	100	301.8	415.3	100	7.2	9.9	100	81276.7	111854.6	100
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Total	135.5	186.5	100	118.2	162.6	100	155.1	213.5	100	301.8	415.3	100	7.2	9.9	100	81276.7	111854.6	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	39	54	6	170	234	1	3	4	0	14	19	3	42	58	2	4661	6415	1
10am-4pm	104	143	16	371	510	3	7	9	0	43	59	8	93	128	3	11172	15376	3
4pm-10pm	237	326	36	1187	1634	10	19	26	1	67	93	13	297	408	11	27745	38185	8
10pm-6am	43	59	7	180	247	2	3	4	0	15	21	3	45	62	2	5020	6909	1
Total	423	582	64	1907	2625	16	31	43	2	140	192	27	477	656	18	48598	66884	14
Motor Vehicles																		
6am-10am	22	31	3	2208	3037	19	360	496	19	18	25	3	489	672	18	44723	61517	13
10am-4pm	45	62	7	4503	6193	38	735	1011	40	37	51	7	997	1371	37	91201	125449	27
4pm-10pm	29	40	4	2914	4008	25	476	654	26	24	33	5	645	887	24	59016	81178	17
10pm-6am	4	6	1	235	323	2	100	138	5	4	5	1	68	94	3	9837	13531	3
Total	101	139	15	9859	13561	83	1671	2299	90	83	114	16	2198	3023	82	204777	281674	60
Industry																		
6am-10am	30	41	4	23	32	0	38	52	2	75	104	14	1	2	0	18387	25305	5
10am-4pm	56	77	8	40	55	0	76	104	4	154	211	29	2	3	0	33930	46696	10
4pm-10pm	33	46	5	29	40	0	37	51	2	72	99	14	2	2	0	21188	29159	6
10pm-6am	17	23	3	26	36	0	5	6	0	1	1	0	2	3	0	14719	20257	4
Total	135	186	21	118	163	1	155	213	8	302	415	58	7	10	0	88225	121417	26
Combined Total																		
6am-10am	91	125	14	2401	3304	20	401	552	22	107	147	20	532	733	20	67771	93268	20
10am-4pm	205	282	31	4913	6761	41	817	1125	44	234	322	45	1091	1502	41	136303	187583	40
4pm-10pm	299	412	45	4130	5684	35	531	731	29	164	225	31	943	1298	35	107949	148562	32
10pm-6am	64	89	10	440	606	4	108	148	6	20	28	4	115	158	4	29577	40704	9
Total	659	907	100	11884	16355	100	1857	2556	100	525	722	100	2682	3691	100	341601	470117	100

Beckenham/Sydenham

	Daily Fuel Quantity			PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg/day	t/day	Use %	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Open fire																					
- Wood	11507	11.5	61	173	311	47	1381	2489	63	19	34	58	2	4	3	345	622	63	19561	35265	45
- Coal	3868	3.9	100	128	230	34	232	418	11	6	10	18	70	126	95	58	105	11	10831	19527	25
Pre 1989 Woodburner																					
- Wood	3714	3.7	20	48	86	13	380	686	17	5	9	16	1	1	1	95	171	17	6313	11381	15
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989-1992 (incl) Woodburner																					
- Wood	1238	1.2	7	9	15	2	68	123	3	1	2	3	0	0	0	17	31	3	2104	3794	5
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post 1993 Woodburner																					
- Wood	2476	2.5	13	15	26	4	117	211	5	2	3	5	0	1	1	29	53	5	4209	7587	10
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enclosed Coal Burner																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pot Belly																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incinerator																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Wood	18934	18.9		243	439	66	1946	3509	89	27	48	82	4	7	5	487	877	89	32188	58027	75
Total Coal	3868	3.9		128	230	34	232	418	11	6	10	18	70	126	95	58	105	11	10831	19527	25
Total Gas	995	1.0		0	0		0	1		2	4		0	0		0	0		2487	4483	
Total Oil	247	0.2		0	1		0	0		1	1		1	2		0	0		791	1425	
Total (Wood and Coal only)	22802	23		371	669	100	2178	3927	100	33	59	100	73	132	100	545	982	100	43019	77554	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Light duty <3.5t petrol vehicles	23	42	29	7076	12757	90	659	1187	49	3	6	5	1462	2636	83	112469	202756	69
Light duty <3.5t diesel vehicles	3	5	3	14	26	0	9	17	1	3	6	5	7	12	0	6710	12097	4
Light duty <3.5t LPG/CNG vehicles	0	0	0	15	28	0	20	35	1	0	0	0	19	35	1	3204	5775	2
Heavy duty >3.5t petrol vehicles	3	5	3	454	818	6	30	55	2	0	0	0	45	82	3	5564	10032	3
Heavy duty >3.5t diesel vehicles	52	94	65	236	425	3	610	1100	46	58	104	87	188	339	11	34369	61959	21
Heavy duty >3.5t LPG/CNG vehicles	0	0	0	15	28	0	5	8	0	0	0	0	8	14	0	793	1429	0
2&4 stroke petrol motorcycles	0	0	0	54	97	1	0	1	0	2	3	3	24	43	1	266	480	0
Total	81	146	100	7864	14177	100	1333	2404	100	66	120	100	1753	3161	100	163375	294529	100

	PM10			CO			NOx			SOx			VOC			CO2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Part A																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Part B																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Part C																		
Combustion	2.5	4.4	100	1.4	2.5	100	5.3	9.5	100	10.2	18.4	100	0.1	0.2	2	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	5.2	9.4	98	0.0	0.0	0
Sub-total	2.5	4.4	100	1.4	2.5	100	5.3	9.5	100	10.2	18.4	100	5.3	9.6	100	0.0	0.0	0
Total																		
Combustion	2.5	4.4	100	1.4	2.5	100	5.3	9.5	100	10.2	18.4	100	0.1	0.2	2	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	5.2	9.4	98	0.0	0.0	0
Total	2.5	4.4	100	1.4	2.5	100	5.3	9.5	100	10.2	18.4	100	5.3	9.6	100	0.0	0.0	0

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	28	50	6	162	292	2	2	4	0	5	10	4	41	73	2	3245	5850	2
10am-4pm	96	173	21	680	1226	7	10	17	1	9	16	6	170	307	7	11057	19933	5
4pm-10pm	230	414	51	1193	2151	12	19	33	1	59	106	39	298	538	13	25410	45809	12
10pm-6am	18	32	4	143	258	1	2	4	0	0	1	0	36	64	2	3307	5962	2
Total	371	669	82	2178	3927	22	33	59	2	73	132	49	545	982	24	43019	77554	21
Motor Vehicles																		
6am-10am	18	32	4	1743	3140	17	284	513	21	14	26	10	386	695	17	35302	63608	17
10am-4pm	36	65	8	3612	6508	36	590	1062	43	30	54	20	799	1440	35	73156	131812	35
4pm-10pm	23	42	5	2321	4182	23	379	683	28	19	35	13	514	926	22	47018	84717	22
10pm-6am	3	6	1	188	339	2	80	145	6	3	5	2	55	98	2	7899	14233	4
Total	81	145	18	7864	14170	78	1333	2402	97	66	120	44	1753	3159	76	163375	294370	78
Industry																		
6am-10am	1	1	0	0	1	0	1	2	0	3	5	2	1	2	0	706	1272	0
10am-4pm	2	3	0	1	2	0	3	6	0	6	12	4	3	6	0	1765	3181	1
4pm-10pm	0	1	0	0	0	0	1	1	0	1	2	1	1	1	0	353	636	0
10pm-6am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	2	4	1	1	3	0	5	10	0	10	18	7	5	10	0	2823	5090	1
Combined Total																		
6am-10am	46	82	10	1905	3435	19	288	520	21	22	40	15	428	771	19	39253	70761	19
10am-4pm	134	241	29	4293	7738	43	602	1086	44	45	81	30	973	1753	42	85978	154990	41
4pm-10pm	253	457	56	3514	6335	35	398	718	29	79	143	53	813	1465	35	72781	131200	35
10pm-6am	21	39	5	331	597	3	82	148	6	3	6	2	90	163	4	11206	20201	5
Total	454	819	100	10044	18106	100	1371	2472	100	150	270	100	2303	4152	100	209218	377153	100

Bishopdale

	Daily Fuel Quantity			PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg/day	t/day	Use %	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Open fire																					
- Wood	8257	8.3	36	124	140	35	991	1118	43	14	15	40	2	2	3	248	279	43	14037	15834	30
- Coal	2417	2.4	100	80	90	23	145	164	6	4	4	11	44	49	90	36	41	6	6768	7634	15
Pre 1989 Woodburner																					
- Wood	8486	8.5	37	109	123	31	869	980	37	12	13	35	2	2	4	217	245	37	14426	16273	31
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989-1992 (incl) Woodburner																					
- Wood	3182	3.2	14	22	25	6	176	198	8	2	3	7	1	1	1	44	50	8	5410	6103	12
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post 1993 Woodburner																					
- Wood	3182	3.2	14	19	21	5	150	169	6	2	2	6	1	1	1	38	42	6	5410	6103	12
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enclosed Coal Burner																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pot Belly																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incinerator																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Wood	23107	23.1		273	308	77	2186	2465	94	30	34	89	5	5	10	546	616	94	39283	44312	85
Total Coal	2417	2.4		80	90	23	145	164	6	4	4	11	44	49	90	36	41	6	6768	7634	15
Total Gas	2189	2.2		0	0		1	1		4	5		0	0		0	0		5473	6174	
Total Oil	0	0.0		0	0		0	0		0	0		0	0		0	0		0	0	
Total (Wood and Coal only)	25525	26		353	398	100	2331	2629	100	34	38	100	48	54	100	583	657	100	46051	51947	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Light duty <3.5t petrol vehicles	9	11	29	2915	3288	90	261	294	49	1	2	5	597	673	83	45116	50892	69
Light duty <3.5t diesel vehicles	1	1	3	6	6	0	4	4	1	1	2	5	3	3	0	2692	3036	4
Light duty <3.5t LPG/CNG vehicles	0	0	0	6	7	0	8	9	1	0	0	0	8	9	1	1285	1450	2
Heavy duty >3.5t petrol vehicles	1	1	3	184	207	6	12	13	2	0	0	0	18	21	3	2232	2518	3
Heavy duty >3.5t diesel vehicles	21	24	64	97	109	3	242	273	46	23	26	87	77	87	11	13787	15552	21
Heavy duty >3.5t LPG/CNG vehicles	0	0	0	6	7	0	2	2	0	0	0	0	3	4	0	318	359	0
2&4 stroke petrol motorcycles	0	0	0	22	24	1	0	0	0	1	1	3	10	11	1	107	121	0
Total	33	37	100	3236	3650	100	528	596	100	27	30	100	716	808	100	65536	73927	100

	PM10			CO			NOx			SOx			VOC			CO2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Part A																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Part B																		
Combustion	0.1	0.1	1	0.2	0.2	2	0.7	0.8	3	1.0	1.2	2	0.0	0.1	1	844.2	952.2	100
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.1	0.1	1	0.2	0.2	2	0.7	0.8	3	1.0	1.2	2	0.0	0.1	1	844.2	952.2	100
Part C																		
Combustion	11.0	12.4	95	7.1	8.0	98	27.0	30.5	97	47.8	53.9	98	0.8	0.9	23	0.0	0.0	0
Other Processes	0.5	0.5	4	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	2.6	2.9	76	0.0	0.0	0
Sub-total	11.4	12.9	99	7.1	8.0	98	27.0	30.5	97	47.8	53.9	98	3.4	3.8	99	0.0	0.0	0
Total																		
Combustion	11.0	12.5	96	7.3	8.2	100	27.8	31.3	100	48.8	55.1	100	0.8	0.9	24	844.2	952.2	100
Other Processes	0.5	0.5	4	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	2.6	2.9	76	0.0	0.0	0
Total	11.5	13.0	100	7.3	8.2	100	27.8	31.3	100	48.8	55.1	100	3.4	3.9	100	844.2	952.2	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	32	36	8	220	248	4	3	4	1	4	4	3	55	62	4	4420	4985	3
10am-4pm	48	54	12	330	373	6	5	5	1	5	6	4	83	93	6	6629	7478	5
4pm-10pm	245	277	62	1557	1756	28	23	26	4	39	44	31	389	439	30	31058	35035	24
10pm-6am	28	31	7	223	252	4	3	3	1	0	1	0	56	63	4	3944	4448	3
Total	353	398	89	2331	2629	42	34	38	6	48	54	39	583	657	45	46051	51947	36
Motor Vehicles																		
6am-10am	7	8	2	720	812	13	118	132	20	6	7	5	159	180	12	14582	16440	11
10am-4pm	14	16	4	1406	1585	25	229	259	39	12	13	9	311	351	24	28471	32098	22
4pm-10pm	10	11	2	948	1069	17	155	174	26	8	9	6	210	237	16	19206	21653	15
10pm-6am	2	2	0	162	182	3	26	30	4	1	2	1	36	40	3	3277	3695	3
Total	33	37	8	3236	3648	58	528	595	90	27	30	22	716	807	55	65536	73885	51
Industry																		
6am-10am	3	3	1	2	2	0	7	8	1	12	14	10	1	1	0	4428	4995	3
10am-4pm	7	8	2	5	5	0	17	20	3	31	34	25	2	2	0	11070	12487	9
4pm-10pm	1	2	0	1	1	0	3	4	1	6	7	5	0	0	0	2214	2497	2
10pm-6am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	12	13	3	7	8	0	28	31	5	49	55	39	3	4	0	17712	19979	14
Combined Total																		
6am-10am	42	47	11	942	1062	17	128	144	22	22	24	18	215	243	17	23429	26428	18
10am-4pm	69	78	17	1740	1963	31	252	284	43	47	54	38	396	446	30	46170	52079	36
4pm-10pm	256	289	65	2506	2827	45	181	204	31	53	59	43	600	676	46	52479	59195	41
10pm-6am	30	33	7	385	434	7	29	33	5	2	2	1	92	103	7	7221	8145	6
Total	397	448	100	5573	6287	100	590	665	100	124	139	100	1302	1469	100	129299	145847	100

Bromley

	Daily Fuel Quantity			PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg/day	t/day	Use %	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Open fire																					
- Wood	1548	1.5	18	23	30	18	186	243	23	3	3	21	0	0	1	46	61	23	2631	3443	14
- Coal	605	0.6	48	20	26	15	36	47	4	1	1	8	11	14	45	9	12	4	1693	2215	9
Pre 1989 Woodburner																					
- Wood	3482	3.5	40	45	58	34	357	467	43	5	6	41	1	1	3	89	117	43	5919	7748	32
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989-1992 (incl) Woodburner																					
- Wood	1451	1.5	17	10	13	8	80	105	10	1	1	9	0	0	1	20	26	10	2466	3228	14
- Coal	186	0.2	15	3	4	2	5	7	1	0	0	1	3	4	14	1	2	1	521	682	3
Post 1993 Woodburner																					
- Wood	1741	1.7	20	10	13	8	82	108	10	1	1	9	0	0	1	21	27	10	2960	3874	16
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enclosed Coal Burner																					
- Wood	446	0.4	5	6	8	5	51	67	6	1	1	6	0	0	0	13	17	6	759	993	4
- Coal	465	0.5	37	15	19	11	27	35	3	1	1	6	8	11	34	7	9	3	1302	1704	7
Pot Belly																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incinerator																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Wood	8668	8.7		94	124	72	756	989	92	10	14	86	2	2	7	189	247	92	14735	19287	81
Total Coal	1256	1.3		37	49	28	68	89	8	2	2	14	23	30	93	17	22	8	3515	4601	19
Total Gas	1088	1.1		0	0		0	1		2	3		0	0		0	0		2720	3561	
Total Oil	66	0.1		0	0		0	0		0	0		0	0		0	0		213	278	
Total (Wood and Coal only)	9923	10		132	173	100	824	1078	100	12	16	100	24	32	100	206	269	100	18250	23888	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Light duty <3.5t petrol vehicles	7	9	23	1401	1834	85	349	457	50	1	1	3	397	520	84	47372	62005	69
Light duty <3.5t diesel vehicles	1	1	3	6	8	0	4	5	1	1	2	5	3	4	1	2826	3699	4
Light duty <3.5t LPG/CNG vehicles	0	0	0	4	5	0	8	11	1	0	0	0	8	10	2	1349	1766	2
Heavy duty >3.5t petrol vehicles	1	2	4	152	199	9	21	27	3	0	0	0	15	20	3	2344	3068	3
Heavy duty >3.5t diesel vehicles	21	27	69	49	64	3	316	414	45	23	31	88	39	51	8	14476	18948	21
Heavy duty >3.5t LPG/CNG vehicles	0	0	0	7	9	0	2	3	0	0	0	0	3	4	1	334	437	0
2&4 stroke petrol motorcycles	0	0	0	23	30	1	0	0	0	1	1	3	10	13	2	112	147	0
Total	30	40	100	1641	2147	100	700	917	100	27	35	100	475	622	100	68813	90070	100

	PM10			CO			NOx			SOx			VOC			CO2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Part A																		
Combustion	0.1	0.2	2	0.3	0.3	3	1.2	1.5	4	1.7	2.2	4	0.1	0.1	0	1343.8	1758.9	70
Other Processes	0.3	0.4	5	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	1.1	1.5	2	0.0	0.0	0
Sub-total	0.5	0.6	6	0.3	0.3	3	1.2	1.5	4	1.7	2.2	4	1.2	1.6	2	1343.8	1758.9	70
Part B																		
Combustion	0.0	0.1	1	0.1	0.1	1	0.5	0.7	2	0.7	0.9	2	0.0	0.0	0	572.3	749.1	30
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	8.1	10.6	15	0.0	0.0	0
Sub-total	0.0	0.1	1	0.1	0.1	1	0.5	0.7	2	0.7	0.9	2	8.1	10.6	15	572.3	749.1	30
Part C																		
Combustion	7.0	9.1	93	7.2	9.5	95	26.3	34.4	94	42.6	55.8	95	1.3	1.7	2	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	43.0	56.3	80	0.0	0.0	0
Sub-total	7.0	9.1	93	7.2	9.5	95	26.3	34.4	94	42.6	55.8	95	44.4	58.1	83	0.0	0.0	0
Total																		
Combustion	7.1	9.4	95	7.6	10.0	100	28.0	36.6	100	45.0	58.9	100	1.4	1.9	3	1916.2	2507.9	100
Other Processes	0.3	0.4	5	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	52.2	68.4	97	0.0	0.0	0
Total	7.5	9.8	100	7.6	10.0	100	28.0	36.6	100	45.0	58.9	100	53.7	70.2	100	1916.2	2507.9	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	11	14	6	60	78	2	1	1	0	2	3	3	15	20	2	1363	1784	1
10am-4pm	10	13	6	57	74	2	1	1	0	2	3	2	14	19	2	1526	1998	1
4pm-10pm	85	111	50	549	719	22	8	10	1	15	19	15	137	180	19	12019	15732	11
10pm-6am	26	34	15	158	206	6	2	3	0	5	6	5	39	52	5	3342	4374	3
Total	132	173	78	824	1078	33	12	16	2	24	32	25	206	269	28	18250	23888	16
Motor Vehicles																		
6am-10am	7	9	4	360	472	15	154	201	21	6	8	6	104	137	14	15115	19783	13
10am-4pm	13	17	8	717	939	29	306	401	41	12	15	12	208	272	28	30077	39368	27
4pm-10pm	9	12	5	484	633	20	207	270	28	8	10	8	140	184	19	20294	26563	18
10pm-6am	1	2	1	79	104	3	34	44	5	1	2	1	23	30	3	3327	4355	3
Total	30	40	18	1641	2147	66	700	917	95	27	35	28	475	622	65	68813	90070	61
Industry																		
6am-10am	2	2	1	2	2	0	7	9	1	11	15	12	13	18	2	6517	8530	6
10am-4pm	5	6	3	5	6	0	17	22	2	28	36	29	32	42	4	15886	20792	14
4pm-10pm	1	1	1	1	1	0	4	5	1	6	8	6	8	11	1	3666	4798	3
10pm-6am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	7	10	4	8	10	0	28	37	4	45	59	47	54	70	7	26070	34121	23
Combined Total																		
6am-10am	19	25	11	422	552	17	162	212	22	20	26	20	133	174	18	22995	30097	20
10am-4pm	28	36	16	779	1019	32	324	424	44	41	54	43	254	333	35	47489	62155	42
4pm-10pm	95	125	56	1034	1354	42	218	286	29	29	37	30	286	374	39	35980	47091	32
10pm-6am	28	36	16	237	310	10	36	47	5	6	8	7	62	82	8	6669	8728	6
Total	170	222	100	2472	3235	100	740	969	100	96	125	100	735	962	100	113133	148072	100

Burnside/Bryndwr

	Daily Fuel Quantity			PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg/day	t/day	Use %	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Open fire																					
- Wood	14007	14.0	33	210	457	25	1681	3658	37	23	50	33	3	6	1	420	914	37	23811	51820	23
- Coal	4808	4.8	43	159	345	19	288	628	6	7	16	10	87	188	42	72	157	6	13462	29298	13
Pre 1989 Woodburner																					
- Wood	14893	14.9	35	191	415	23	1525	3319	33	21	46	30	3	6	1	381	830	33	25319	55100	25
- Coal	1923	1.9	17	54	118	6	98	214	2	2	5	4	35	75	17	25	54	2	5385	11719	5
1989-1992 (incl) Woodburner																					
- Wood	5416	5.4	13	37	81	4	299	651	6	4	9	6	1	2	1	75	163	6	9207	20036	9
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post 1993 Woodburner																					
- Wood	6770	6.8	16	40	87	5	320	695	7	4	10	6	1	3	1	80	174	7	11508	25046	11
- Coal	481	0.5	4	6	14	1	11	25	0	0	1	0	9	19	4	3	6	0	1346	2930	1
Enclosed Coal Burner																					
- Wood	1404	1.4	3	20	44	2	161	350	3	2	5	3	0	1	0	40	87	3	2387	5194	2
- Coal	3846	3.8	35	121	263	14	220	479	5	6	12	8	69	151	33	55	120	5	10770	23438	10
Pot Belly																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incinerator																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Wood	42489	42.5		498	1084	59	3985	8672	87	55	119	78	8	18	4	996	2168	87	72232	15719	70
Total Coal	11058	11.1		340	740	41	618	1346	13	15	34	22	199	433	96	155	336	13	30964	67385	30
Total Gas	615	0.6		0	0		0	1		1	3		0	0		0	0		1537	3345	
Total Oil	247	0.2		0	1		0	0		1	1		1	2		0	0		791	1722	
Total (Wood and Coal only)	53548	54		838	1824	100	4603	10018	100	70	153	100	208	452	100	1151	2504	100	10319	22458	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Light duty <3.5t petrol vehicles	11	25	29	3461	7531	90	322	701	49	2	4	5	715	1556	83	55035	119771	69
Light duty <3.5t diesel vehicles	1	3	3	7	15	0	5	10	1	2	4	5	3	7	0	3283	7146	4
Light duty <3.5t LPG/CNG vehicles	0	0	0	8	16	0	10	21	1	0	0	0	9	21	1	1568	3412	2
Heavy duty >3.5t petrol vehicles	1	3	3	222	483	6	15	32	2	0	0	0	22	48	3	2723	5926	3
Heavy duty >3.5t diesel vehicles	26	56	65	115	251	3	299	650	46	28	61	87	92	200	11	16818	36600	21
Heavy duty >3.5t LPG/CNG vehicles	0	0	0	8	16	0	2	5	0	0	0	0	4	8	0	388	844	0
2&4 stroke petrol motorcycles	0	0	0	26	57	1	0	0	0	1	2	3	12	26	1	130	284	0
Total	39	86	100	3846	8370	100	653	1420	100	32	71	100	858	1867	100	79945	173982	100

	PM10			CO			NOx			SOx			VOC			CO2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Part A																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Part B																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Part C																		
Combustion	0.7	1.6	100	0.4	0.9	100	1.5	3.3	100	3.0	6.5	100	0.0	0.1	100	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.7	1.6	100	0.4	0.9	100	1.5	3.3	100	3.0	6.5	100	0.0	0.1	100	0.0	0.0	0
Total																		
Combustion	0.7	1.6	100	0.4	0.9	100	1.5	3.3	100	3.0	6.5	100	0.0	0.1	100	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Total	0.7	1.6	100	0.4	0.9	100	1.5	3.3	100	3.0	6.5	100	0.0	0.1	100	0.0	0.0	0

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	48	104	5	230	501	3	4	8	1	17	38	7	58	125	3	7177	15620	4
10am-4pm	119	259	14	689	1499	8	10	23	1	28	62	12	172	375	9	16653	36242	9
4pm-10pm	516	1122	59	2926	6367	35	44	96	6	114	247	47	731	1592	36	60086	130764	33
10pm-6am	156	339	18	759	1651	9	12	26	2	48	105	20	190	413	9	19279	41956	10
Total	838	1824	95	4603	10018	54	70	153	10	208	452	85	1151	2504	57	103195	224582	56
Motor Vehicles																		
6am-10am	8	18	1	844	1835	10	138	299	19	7	15	3	187	406	9	17095	37163	9
10am-4pm	18	38	2	1748	3800	21	285	620	39	14	31	6	387	841	19	35403	76963	19
4pm-10pm	12	25	1	1160	2522	14	189	412	26	10	21	4	257	558	13	23501	51089	13
10pm-6am	2	4	0	94	205	1	40	87	6	2	3	1	27	59	1	3946	8579	2
Total	39	86	4	3846	8361	45	653	1419	90	32	71	13	858	1865	43	79945	173793	43
Industry																		
6am-10am	0	0	0	0	0	0	0	1	0	1	2	0	0	0	0	188	410	0
10am-4pm	0	1	0	0	1	0	1	2	0	2	4	1	0	0	0	471	1024	0
4pm-10pm	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	94	205	0
10pm-6am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1	2	0	0	1	0	2	3	0	3	7	1	0	0	0	753	1639	0
Combined Total																		
6am-10am	56	123	6	1074	2338	13	142	309	20	25	55	10	244	532	12	24460	53232	13
10am-4pm	137	298	16	2437	5303	29	297	645	41	45	97	18	559	1217	28	52527	114311	29
4pm-10pm	527	1148	60	4086	8892	48	234	509	32	124	269	51	988	2151	49	83681	182110	46
10pm-6am	157	343	18	853	1856	10	52	114	7	50	108	20	217	472	11	23225	50544	13
Total	878	1912	100	8450	18389	100	724	1576	100	243	529	100	2009	4371	100	183893	400196	100

Inner City

	Daily Fuel Quantity			PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg/day	t/day	Use %	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Open fire																					
- Wood	10596	10.6	75	159	250	49	1272	2004	72	17	28	65	2	3	3	318	501	72	18013	28385	51
- Coal	3953	4.0	100	130	206	41	237	374	13	6	9	22	71	112	96	59	93	13	11069	17442	31
Pre 1989 Woodburner																					
- Wood	1442	1.4	10	18	29	6	148	233	8	2	3	8	0	0	0	37	58	8	2452	3863	7
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989-1992 (incl) Woodburner																					
- Wood	721	0.7	5	5	8	2	40	63	2	1	1	2	0	0	0	10	16	2	1226	1932	3
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post 1993 Woodburner																					
- Wood	1442	1.4	10	9	13	3	68	107	4	1	1	3	0	0	0	17	27	4	2452	3863	7
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enclosed Coal Burner																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pot Belly																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incinerator																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Wood	14202	14.2		191	301	59	1527	2406	87	21	33	78	3	4	4	382	602	87	24143	38044	69
Total Coal	3953	4.0		130	206	41	237	374	13	6	9	22	71	112	96	59	93	13	11069	17442	31
Total Gas	652	0.7		0	0		0	0		1	2		0	0		0	0		1629	2568	
Total Oil	0	0.0		0	0		0	0		0	0		0	0		0	0		0	0	
Total (Wood and Coal only)	18155	18		321	506	100	1764	2780	100	27	42	100	74	117	100	441	695	100	35211	55486	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Light duty <3.5t petrol vehicles	43	67	29	13163	20743	90	1177	1855	49	6	10	5	2696	4249	83	203733	321042	69
Light duty <3.5t diesel vehicles	5	7	3	26	41	0	17	26	1	6	10	5	12	19	0	12155	19154	4
Light duty <3.5t LPG/CNG vehicles	0	0	0	28	45	0	36	56	1	0	0	0	35	55	1	5803	9145	2
Heavy duty >3.5t petrol vehicles	5	7	3	830	1308	6	53	84	2	0	1	0	83	131	3	10080	15884	3
Heavy duty >3.5t diesel vehicles	95	149	64	438	690	3	1093	1722	46	105	165	87	349	550	11	62258	98106	21
Heavy duty >3.5t LPG/CNG vehicles	0	0	0	28	44	0	8	13	0	0	0	0	14	23	0	1436	2263	0
2&4 stroke petrol motorcycles	0	1	0	98	154	1	1	1	0	3	5	3	44	69	1	482	760	0
Total	147	232	100	14611	23024	100	2385	3758	100	121	190	100	3234	5096	100	295948	466354	100

	PM10			CO			NOx			SOx			VOC			CO2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Part A																		
Combustion	127.2	200.5	43	64.3	101.3	41	231.7	365.2	42	446.3	703.3	41	1.7	2.7	1	63811.1	100551.7	49
Other Processes	5.0	7.9	2	0.0	0.0	0	0.9	1.4	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	132.2	208.3	45	64.3	101.3	41	232.6	366.5	42	446.3	703.3	41	1.7	2.7	1	63811.1	100551.7	49
Part B																		
Combustion	120.6	190.1	41	57.5	90.7	37	204.7	322.6	37	427.1	673.0	40	2.0	3.1	1	66687.5	105084.3	51
Other Processes	0.0	0.1	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	19.2	30.3	14	0.0	0.0	0
Sub-total	120.6	190.1	41	57.5	90.7	37	204.7	322.6	37	427.1	673.0	40	21.2	33.4	15	66687.5	105084.3	51
Part C																		
Combustion	43.2	68.0	15	33.5	52.9	22	120.9	190.5	22	205.9	324.4	19	4.5	7.1	3	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	114.4	180.3	81	0.0	0.0	0
Sub-total	43.2	68.0	15	33.5	52.9	22	120.9	190.5	22	205.9	324.4	19	118.9	187.4	84	0.0	0.0	0
Total																		
Combustion	291.0	458.6	98	155.4	244.9	100	557.4	878.3	100	1079.3	1700.8	100	8.2	12.9	6	130498.5	205636.0	100
Other Processes	5.0	7.9	2	0.0	0.0	0	0.9	1.4	0	0.0	0.0	0	133.6	210.5	94	0.0	0.0	0
Total	296.0	466.5	100	155.4	244.9	100	558.2	879.6	100	1079.3	1700.8	100	141.8	223.4	100	130498.5	205636.0	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	4	6	0	30	47	0	0	1	0	0	0	0	8	12	0	550	867	0
10am-4pm	41	64	5	274	432	2	4	6	0	5	8	0	69	108	2	5026	7919	1
4pm-10pm	266	420	35	1377	2170	8	21	34	1	69	108	5	344	542	9	27834	43860	5
10pm-6am	10	16	1	83	131	1	1	2	0	0	0	0	21	33	1	1801	2839	0
Total	321	506	42	1764	2780	11	27	42	1	74	117	6	441	695	12	35211	55486	6
Motor Vehicles																		
6am-10am	32	51	4	3220	5071	19	526	828	18	27	42	2	713	1122	19	65222	102711	12
10am-4pm	67	106	9	6663	10492	40	1088	1713	37	55	87	4	1475	2322	39	134953	212525	24
4pm-10pm	41	64	5	4042	6365	24	660	1039	22	33	53	3	894	1409	23	81863	128919	15
10pm-6am	7	11	1	687	1081	4	112	177	4	6	9	0	152	239	4	13910	21905	3
Total	147	231	19	14611	23009	88	2385	3756	80	121	190	9	3234	5092	85	295948	466060	54
Industry																		
6am-10am	52	82	7	28	44	0	101	160	3	192	303	15	35	55	1	44214	69671	8
10am-4pm	97	153	13	54	86	0	195	308	7	365	575	29	86	136	2	93719	147680	17
4pm-10pm	73	115	10	37	58	0	132	208	4	260	410	20	19	31	1	45677	71977	8
10pm-6am	74	117	10	36	57	0	130	204	4	262	412	21	1	2	0	36581	57643	7
Total	296	466	39	155	245	1	558	880	19	1079	1701	85	142	223	4	220191	346971	40
Combined Total																		
6am-10am	88	139	12	3278	5166	20	627	989	21	219	345	17	755	1190	20	109986	173313	20
10am-4pm	205	323	27	6991	11017	42	1287	2028	43	425	670	33	1629	2568	43	233698	368255	42
4pm-10pm	380	599	50	5455	8596	33	813	1281	27	362	571	28	1258	1982	33	155374	244834	28
10pm-6am	92	145	12	806	1270	5	243	383	8	268	422	21	174	274	5	52292	82400	9
Total	764	1204	100	16531	26048	100	2970	4680	100	1274	2007	100	3817	6014	100	551351	868803	100

Fendalton

	Daily Fuel Quantity			PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg/day	t/day	Use %	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Open fire																					
- Wood	20454	20.5	54	307	412	34	2455	3295	54	34	45	48	4	5	2	614	824	54	34773	46675	34
- Coal	12023	12.0	86	397	533	44	721	968	16	18	24	25	216	290	83	180	242	16	33664	45186	33
Pre 1989 Woodburner																					
- Wood	7565	7.6	20	97	130	11	775	1040	17	11	14	15	2	2	1	194	260	17	12860	17262	12
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989-1992 (incl) Woodburner																					
- Wood	4323	4.3	11	30	40	3	239	320	5	3	4	5	1	1	0	60	80	5	7349	9864	7
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post 1993 Woodburner																					
- Wood	5403	5.4	14	32	43	4	255	342	6	4	5	5	1	1	0	64	86	6	9186	12330	9
- Coal	1312	1.3	9	17	23	2	31	42	1	1	1	1	24	32	9	8	10	1	3672	4929	4
Enclosed Coal Burner																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	656	0.7	5	21	28	2	38	50	1	1	1	1	12	16	5	9	13	1	1836	2465	2
Pot Belly																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incinerator																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Wood	37746	37.7	73	465	625	52	3723	4997	82	51	69	72	8	10	3	931	1249	82	64168	86131	62
Total Coal	13990	14.0	27	434	583	48	790	1060	18	20	27	28	252	338	97	197	265	18	39172	52580	38
Total Gas	1902	1.9		0	0		1	1		4	5		0	0		0	1		4754	6382	
Total Oil	7286	7.3		9	13		4	6		16	22		28	37		2	2		23316	31297	
Total (Wood and Coal only)	51736	52		900	1208	100	4513	6057	100	71	95	100	259	348	100	1128	1514	100	103340	138711	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Light duty <3.5t petrol vehicles	19	26	29	5977	8023	90	535	717	49	3	4	5	1224	1643	83	92505	124167	69
Light duty <3.5t diesel vehicles	2	3	3	12	16	0	8	10	1	3	4	5	6	7	0	5519	7408	4
Light duty <3.5t LPG/CNG vehicles	0	0	0	13	17	0	16	22	1	0	0	0	16	21	1	2635	3537	2
Heavy duty >3.5t petrol vehicles	2	3	3	377	506	6	24	33	2	0	0	0	38	51	3	4577	6143	3
Heavy duty >3.5t diesel vehicles	43	58	64	199	267	3	496	666	46	48	64	87	159	213	11	28268	37944	21
Heavy duty >3.5t LPG/CNG vehicles	0	0	0	13	17	0	4	5	0	0	0	0	7	9	0	652	875	0
2&4 stroke petrol motorcycles	0	0	0	44	59	1	0	1	0	1	2	3	20	27	1	219	294	0
Total	67	90	100	6634	8905	100	1083	1453	100	55	73	100	1468	1971	100	134375	180369	100

	PM10			CO			NOx			SOx			VOC			CO2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Part A																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Part B																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Part C																		
Combustion	12.5	16.8	100	6.6	8.8	100	21.8	29.2	100	44.8	60.1	100	0.3	0.4	100	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	12.5	16.8	100	6.6	8.8	100	21.8	29.2	100	44.8	60.1	100	0.3	0.4	100	0.0	0.0	0
Total																		
Combustion	12.5	16.8	100	6.6	8.8	100	21.8	29.2	100	44.8	60.1	100	0.3	0.4	100	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Total	12.5	16.8	100	6.6	8.8	100	21.8	29.2	100	44.8	60.1	100	0.3	0.4	100	0.0	0.0	0

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	69	93	7	298	399	3	5	7	0	26	35	7	74	100	3	8406	11283	3
10am-4pm	78	105	8	399	536	4	6	8	1	24	33	7	100	134	4	10406	13967	4
4pm-10pm	702	943	72	3453	4635	31	55	73	5	200	269	56	863	1159	33	75610	101490	31
10pm-6am	50	67	5	363	487	3	5	7	0	9	12	2	91	122	3	8918	11970	4
Total	900	1208	92	4513	6057	40	71	95	6	259	348	72	1128	1514	43	103340	138711	42
Motor Vehicles																		
6am-10am	14	19	1	1438	1930	13	235	315	20	12	16	3	318	427	12	29117	39084	12
10am-4pm	29	40	3	2931	3934	26	478	642	41	24	32	7	649	871	25	59364	79684	24
4pm-10pm	19	26	2	1931	2592	17	315	423	27	16	21	4	427	574	16	39118	52507	16
10pm-6am	3	5	0	334	449	3	55	73	5	3	4	1	74	99	3	6775	9094	3
Total	67	90	7	6634	8905	59	1083	1453	92	55	73	15	1468	1971	57	134375	180369	55
Industry																		
6am-10am	3	4	0	2	2	0	5	7	0	10	14	3	0	0	0	2029	2724	1
10am-4pm	7	9	1	4	5	0	12	16	1	24	33	7	0	0	0	4842	6499	2
4pm-10pm	2	3	0	1	1	0	3	4	0	7	9	2	0	0	0	1244	1670	1
10pm-6am	1	1	0	0	1	0	1	2	0	3	4	1	0	0	0	401	539	0
Total	13	17	1	7	9	0	22	29	2	45	60	12	0	0	0	8516	11431	3
Combined Total																		
6am-10am	87	117	9	1737	2331	16	245	328	21	48	64	13	393	527	15	39552	53092	16
10am-4pm	115	154	12	3334	4475	30	497	667	42	73	98	20	749	1005	29	74612	100152	30
4pm-10pm	724	971	74	5385	7229	48	373	501	32	223	300	62	1291	1733	50	115972	155671	47
10pm-6am	54	72	6	698	937	6	61	82	5	14	19	4	165	221	6	16094	21604	7
Total	979	1314	100	11153	14971	100	1176	1578	100	359	482	100	2597	3486	100	246230	330519	100

Hoon Hay

	Daily Fuel Quantity			PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg/day	t/day	Use %	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Open fire																					
- Wood	6517	6.5	19	98	232	21	782	1856	24	11	26	23	1	3	2	196	464	24	11079	26290	17
- Coal	2830	2.8	100	93	222	20	170	403	5	4	10	9	51	121	88	42	101	5	7923	18801	12
Pre 1989 Woodburner																					
- Wood	15695	15.7	45	201	477	43	1607	3814	50	22	52	48	3	7	5	402	953	50	26681	63316	40
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989-1992 (incl) Woodburner																					
- Wood	6278	6.3	18	43	103	9	347	822	11	5	11	10	1	3	2	87	206	11	10672	25326	16
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post 1993 Woodburner																					
- Wood	6278	6.3	18	37	88	8	296	703	9	4	10	9	1	3	2	74	176	9	10672	25326	16
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enclosed Coal Burner																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pot Belly																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incinerator																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Wood	34768	34.8		379	899	80	3032	7195	95	42	99	91	7	17	12	758	1799	95	59105	14025	88
Total Coal	2830	2.8		93	222	20	170	403	5	4	10	9	51	121	88	42	101	5	7923	18801	12
Total Gas	597	0.6		0	0		0	1		1	3		0	0		0	0		1493	3544	
Total Oil	9	0.0		0	0		0	0		0	0		0	0		0	0		29	68	
Total (Wood and Coal only)	37597	38		472	1121	100	3202	7598	100	46	109	100	58	137	100	800	1900	100	67028	15906	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Light duty <3.5t petrol vehicles	8	19	25	1943	4612	88	335	794	50	1	2	4	477	1133	83	48558	115231	69
Light duty <3.5t diesel vehicles	1	3	3	6	15	0	4	9	1	1	3	5	3	7	1	2897	6875	4
Light duty <3.5t LPG/CNG vehicles	0	0	0	5	11	0	9	20	1	0	0	0	8	19	1	1383	3282	2
Heavy duty >3.5t petrol vehicles	1	3	4	168	399	8	19	44	3	0	0	0	17	40	3	2402	5701	3
Heavy duty >3.5t diesel vehicles	22	52	67	66	157	3	305	724	45	24	58	88	53	126	9	14839	35213	21
Heavy duty >3.5t LPG/CNG vehicles	0	0	0	7	16	0	2	5	0	0	0	0	3	8	1	342	812	0
2&4 stroke petrol motorcycles	0	0	0	23	55	1	0	0	0	1	2	3	10	25	2	115	273	0
Total	32	77	100	2218	5264	100	673	1598	100	28	66	100	572	1357	100	70537	167387	100

	PM10			CO			NOx			SOx			VOC			CO2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Part A																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Part B																		
Combustion	59.6	141.4	89	27.4	65.0	88	97.7	231.9	88	208.6	494.9	88	0.7	1.7	12	28353.4	67286.0	100
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	59.6	141.4	89	27.4	65.0	88	97.7	231.9	88	208.6	494.9	88	0.7	1.7	12	28353.4	67286.0	100
Part C																		
Combustion	7.5	17.8	11	3.7	8.7	12	13.2	31.4	12	27.4	65.1	12	0.2	0.4	3	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	5.2	12.3	86	0.0	0.0	0
Sub-total	7.5	17.8	11	3.7	8.7	12	13.2	31.4	12	27.4	65.1	12	5.4	12.7	88	0.0	0.0	0
Total																		
Combustion	67.1	159.2	100	31.1	73.7	100	111.0	263.3	100	236.0	560.0	100	0.9	2.1	14	28353.4	67286.0	100
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	5.2	12.3	86	0.0	0.0	0
Total	67.1	159.2	100	31.1	73.7	100	111.0	263.3	100	236.0	560.0	100	6.1	14.4	100	28353.4	67286.0	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	36	84	6	236	560	4	3	8	0	5	11	1	59	140	4	4792	11373	3
10am-4pm	92	219	16	602	1429	11	9	21	1	13	31	4	151	357	11	11774	27939	7
4pm-10pm	263	624	46	1784	4234	33	26	61	3	32	76	10	446	1059	32	38256	90782	22
10pm-6am	82	194	14	579	1374	11	8	19	1	8	18	2	145	344	11	12206	28966	7
Total	472	1121	83	3202	7598	59	46	109	6	58	137	18	800	1900	58	67028	159060	39
Motor Vehicles																		
6am-10am	7	16	1	360	855	7	154	365	19	6	14	2	104	248	8	15102	35871	9
10am-4pm	14	33	2	740	1758	14	316	751	38	12	28	4	215	510	16	31048	73749	18
4pm-10pm	10	25	2	1038	2465	19	169	402	20	9	20	3	230	546	17	21020	49930	12
10pm-6am	1	4	0	80	191	1	34	81	4	1	3	0	23	55	2	3367	7996	2
Total	32	77	6	2218	5269	41	673	1599	81	28	66	9	572	1358	42	70537	167546	41
Industry																		
6am-10am	12	28	2	5	13	0	20	47	2	42	99	13	1	3	0	5936	14088	3
10am-4pm	20	46	3	9	22	0	33	78	4	69	164	22	4	8	0	10092	23949	6
4pm-10pm	16	38	3	7	17	0	26	62	3	56	132	17	1	2	0	7689	18247	5
10pm-6am	20	47	3	9	22	0	33	77	4	69	165	22	0	1	0	9442	22406	6
Total	67	159	12	31	74	1	111	263	13	236	560	73	6	14	0	33159	78689	19
Combined Total																		
6am-10am	54	128	9	602	1428	11	177	419	21	52	124	16	165	391	12	25830	61298	15
10am-4pm	126	298	22	1352	3208	25	357	848	43	94	224	29	369	875	27	52914	125570	31
4pm-10pm	289	686	51	2829	6714	52	221	525	27	96	229	30	677	1606	49	66965	158916	39
10pm-6am	103	244	18	669	1587	12	75	178	9	79	186	24	168	399	12	25015	59362	15
Total	572	1357	100	5451	12936	100	830	1970	100	322	763	100	1378	3271	100	170723	405147	100

Hornby

	Daily Fuel Quantity			PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg/day	t/day	Use %	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Open fire																					
- Wood	3456	3.5	19	52	104	12	415	833	20	6	11	17	1	1	1	104	208	20	5875	11795	11
- Coal	4661	4.7	64	154	309	35	280	562	13	7	14	21	84	168	62	70	140	13	13052	26204	26
Pre 1989 Woodburner																					
- Wood	7716	7.7	43	99	198	22	790	1586	38	11	22	33	2	3	1	198	397	38	13116	26333	26
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989-1992 (incl) Woodburner																					
- Wood	3086	3.1	17	21	43	5	170	342	8	2	5	7	1	1	0	43	86	8	5247	10533	10
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post 1993 Woodburner																					
- Wood	2315	2.3	13	14	27	3	109	219	5	2	3	4	0	1	0	27	55	5	3935	7900	8
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enclosed Coal Burner																					
- Wood	804	0.8	4	11	23	3	92	185	4	1	3	4	0	0	0	23	46	4	1366	2743	3
- Coal	2679	2.7	36	84	169	19	153	308	7	4	8	11	48	97	36	38	77	7	7501	15060	15
Pot Belly																					
- Wood	589	0.6	3	8	17	2	67	135	3	1	2	3	0	0	0	17	34	3	1002	2012	2
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incinerator																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Wood	17965	18.0		205	413	46	1644	3300	79	23	45	68	4	7	3	411	825	79	30541	61315	60
Total Coal	7340	7.3		238	478	54	433	869	21	11	22	32	132	265	97	108	217	21	20553	41263	40
Total Gas	658	0.7		0	0		0	1		1	3		0	0		0	0		1646	3304	
Total Oil	138	0.1		0	0		0	0		0	1		1	1		0	0		441	885	
Total (Wood and Coal only)	25306	25		444	891	100	2077	4169	100	33	67	100	136	272	100	519	1042	100	51094	10257	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Light duty <3.5t petrol vehicles	10	21	29	3122	6267	90	291	583	49	1	3	5	645	1295	83	49621	99620	69
Light duty <3.5t diesel vehicles	1	2	3	6	13	0	4	8	1	1	3	5	3	6	0	2960	5944	4
Light duty <3.5t LPG/CNG vehicles	0	0	0	7	14	0	9	17	1	0	0	0	9	17	1	1413	2838	2
Heavy duty >3.5t petrol vehicles	1	2	3	200	402	6	13	27	2	0	0	0	20	40	3	2455	4929	3
Heavy duty >3.5t diesel vehicles	23	46	65	104	209	3	269	541	46	25	51	87	83	166	11	15163	30442	21
Heavy duty >3.5t LPG/CNG vehicles	0	0	0	7	14	0	2	4	0	0	0	0	3	7	0	350	702	0
2&4 stroke petrol motorcycles	0	0	0	24	48	1	0	0	0	1	2	3	11	21	1	118	236	0
Total	36	71	100	3469	6965	100	588	1181	100	29	59	100	774	1553	100	72080	144710	100

	PM10			CO			NOx			SOx			VOC			CO2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Part A																		
Combustion	40.9	82.1	29	21.2	42.5	74	77.0	154.6	73	147.6	296.3	30	0.7	1.5	0	23967.2	48121.4	80
Other Processes	90.3	181.4	64	0.0	0.0	0	0.0	0.0	0	289.0	580.4	60	335.6	673.9	96	0.0	0.0	0
Sub-total	131.2	263.5	93	21.2	42.5	74	77.0	154.6	73	436.6	876.7	90	336.4	675.4	96	23967.2	48121.4	80
Part B																		
Combustion	3.6	7.2	3	2.5	5.0	9	9.7	19.5	9	16.8	33.7	3	0.3	0.6	0	6091.7	12231.0	20
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	3.2	6.4	1	0.0	0.0	0
Sub-total	3.6	7.2	3	2.5	5.0	9	9.7	19.5	9	16.8	33.7	3	3.5	7.0	1	6091.7	12231.0	20
Part C																		
Combustion	5.8	11.6	4	4.9	9.9	17	18.5	37.2	18	30.6	61.4	6	0.7	1.5	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	10.4	20.9	3	0.0	0.0	0
Sub-total	5.8	11.6	4	4.9	9.9	17	18.5	37.2	18	30.6	61.4	6	11.1	22.4	3	0.0	0.0	0
Total																		
Combustion	50.2	100.9	36	28.6	57.4	100	105.2	211.2	100	195.0	391.5	40	1.8	3.6	1	30058.9	60352.4	100
Other Processes	90.3	181.4	64	0.0	0.0	0	0.0	0.0	0	289.0	580.4	60	349.2	701.2	99	0.0	0.0	0
Total	140.6	282.2	100	28.6	57.4	100	105.2	211.2	100	484.0	971.8	100	351.0	704.8	100	30058.9	60352.4	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	25	49	4	150	302	3	2	4	0	4	9	1	38	75	2	3419	6864	2
10am-4pm	106	214	17	459	921	8	8	15	1	36	72	6	115	230	7	11891	23872	7
4pm-10pm	247	496	40	1129	2268	20	18	37	3	78	157	12	282	567	17	28233	56681	17
10pm-6am	66	132	11	338	679	6	5	11	1	17	34	3	85	170	5	7552	15161	5
Total	444	891	72	2077	4169	37	33	67	5	136	272	21	519	1042	32	51094	102579	31
Motor Vehicles																		
6am-10am	8	16	1	790	1586	14	129	259	18	7	13	1	175	351	11	15994	32117	10
10am-4pm	16	32	3	1604	3221	29	262	526	36	13	27	2	355	713	22	32488	65238	19
4pm-10pm	10	20	2	992	1993	18	162	325	22	8	16	1	220	441	13	20102	40365	12
10pm-6am	2	3	0	83	167	1	36	71	5	1	3	0	24	49	1	3496	7019	2
Total	36	72	6	3469	6967	62	588	1181	81	29	59	5	774	1553	47	72080	144739	43
Industry																		
6am-10am	27	53	4	7	13	0	24	48	3	93	186	14	60	120	4	10035	20148	6
10am-4pm	42	83	7	11	23	0	41	83	6	148	297	23	92	186	6	19156	38462	11
4pm-10pm	34	68	5	6	12	0	22	45	3	114	230	18	86	173	5	8752	17573	5
10pm-6am	39	78	6	5	9	0	17	35	2	129	259	20	113	226	7	6298	12645	4
Total	141	282	23	29	57	1	105	211	14	484	972	75	351	705	21	44241	88827	26
Combined Total																		
6am-10am	59	119	10	946	1900	17	155	311	21	104	208	16	272	546	17	29448	59125	18
10am-4pm	164	329	26	2074	4164	37	311	624	43	197	396	30	562	1128	34	63535	127567	38
4pm-10pm	291	583	47	2128	4273	38	203	407	28	201	403	31	588	1181	36	57087	114620	34
10pm-6am	106	213	17	427	856	8	58	117	8	147	296	23	221	444	13	17346	34827	10
Total	620	1244	100	5575	11193	100	727	1459	100	649	1303	100	1644	3300	100	167416	336138	100

Linwood

	Daily Fuel Quantity			PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg/day	t/day	Use %	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Open fire																					
- Wood	13416	13.4	42	201	267	33	1610	2135	46	22	29	42	3	4	2	402	534	46	22807	30252	31
- Coal	2509	2.5	38	83	110	14	151	200	4	4	5	7	45	60	36	38	50	4	7026	9319	10
Pre 1989 Woodburner																					
- Wood	8565	8.6	27	110	145	18	877	1163	25	12	16	23	2	2	1	219	291	25	14560	19313	20
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989-1992 (incl) Woodburner																					
- Wood	4282	4.3	13	30	39	5	236	314	7	3	4	6	1	1	1	59	78	7	7280	9656	10
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post 1993 Woodburner																					
- Wood	4282	4.3	13	25	34	4	202	268	6	3	4	5	1	1	1	51	67	6	7280	9656	10
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enclosed Coal Burner																					
- Wood	1673	1.7	5	24	32	4	191	254	5	3	3	5	0	0	0	48	63	5	2844	3772	4
- Coal	4182	4.2	63	132	175	22	239	317	7	6	8	11	75	100	59	60	79	7	11710	15532	16
Pot Belly																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incinerator																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Wood	32218	32.2		390	517	65	3117	4134	89	43	57	81	6	9	5	779	1034	89	54771	72650	75
Total Coal	6691	6.7		214	284	35	390	517	11	10	13	19	120	160	95	97	129	11	18735	24851	25
Total Gas	4027	4.0		0	1		2	2		8	11		0	0		1	1		10067	13353	
Total Oil	645	0.6		1	1		0	1		1	2		2	3		0	0		2065	2739	
Total (Wood and Coal only)	38909	39		604	801	100	3507	4651	100	53	70	100	127	168	100	877	1163	100	73506	97501	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Light duty <3.5t petrol vehicles	28	37	29	8710	11553	90	779	1033	49	4	5	5	1784	2366	83	134809	178815	69
Light duty <3.5t diesel vehicles	3	4	3	17	23	0	11	15	1	4	5	5	8	11	0	8043	10668	4
Light duty <3.5t LPG/CNG vehicles	0	0	0	19	25	0	24	31	1	0	0	0	23	31	1	3840	5094	2
Heavy duty >3.5t petrol vehicles	3	4	3	549	729	6	35	47	2	0	0	0	55	73	3	6670	8847	3
Heavy duty >3.5t diesel vehicles	63	83	64	290	384	3	723	959	46	69	92	87	231	307	11	41196	54643	21
Heavy duty >3.5t LPG/CNG vehicles	0	0	0	18	25	0	6	7	0	0	0	0	10	13	0	950	1261	0
2&4 stroke petrol motorcycles	0	0	0	65	86	1	1	1	0	2	3	3	29	38	1	319	423	0
Total	97	129	100	9668	12824	100	1578	2093	100	80	106	100	2140	2838	100	195827	259752	100

	PM10			CO			NOx			SOx			VOC			CO2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Part A																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Part B																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	26.8	35.6	100
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	2.0	2.6	9	0.0	0.0	0
Sub-total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	2.0	2.6	9	26.8	35.6	100
Part C																		
Combustion	4.6	6.1	100	4.2	5.6	100	10.6	14.1	100	18.4	24.5	100	0.5	0.7	2	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	18.2	24.1	88	0.0	0.0	0
Sub-total	4.6	6.1	100	4.2	5.6	100	10.6	14.1	100	18.4	24.5	100	18.7	24.8	91	0.0	0.0	0
Total																		
Combustion	4.6	6.1	100	4.2	5.6	100	10.7	14.1	100	18.5	24.5	100	0.5	0.7	2	26.8	35.6	100
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	20.2	26.7	98	0.0	0.0	0
Total	4.6	6.1	100	4.2	5.6	100	10.7	14.1	100	18.5	24.5	100	20.6	27.4	100	26.8	35.6	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	17	22	2	134	178	1	2	2	0	0	0	0	34	44	1	2973	3943	1
10am-4pm	94	125	13	497	659	4	8	10	0	23	31	10	124	165	4	10779	14297	4
4pm-10pm	434	575	61	2401	3185	18	37	48	2	102	136	45	600	796	20	51993	68965	19
10pm-6am	59	79	8	474	629	4	7	9	0	1	1	0	119	157	4	7762	10296	3
Total	604	801	86	3507	4651	27	53	70	3	127	168	56	877	1163	29	73506	97501	26
Motor Vehicles																		
6am-10am	21	28	3	2086	2767	16	341	452	21	17	23	8	462	612	15	42258	56046	15
10am-4pm	43	57	6	4250	5636	32	694	920	42	35	46	16	941	1247	31	86078	114161	31
4pm-10pm	29	38	4	2846	3774	22	464	616	28	23	31	10	630	835	21	57640	76446	21
10pm-6am	5	6	1	486	645	4	79	105	5	4	5	2	108	143	4	9851	13064	4
Total	97	129	14	9668	12822	73	1578	2093	96	80	106	35	2140	2838	70	195827	259717	70
Industry																		
6am-10am	1	2	0	1	1	0	3	4	0	5	6	2	5	7	0	2117	2808	1
10am-4pm	3	4	0	3	3	0	7	9	0	12	15	5	13	17	0	5289	7016	2
4pm-10pm	1	1	0	1	1	0	1	2	0	2	3	1	3	4	0	1062	1409	0
10pm-6am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	5	6	1	4	6	0	11	14	1	18	25	8	21	27	1	8468	11233	3
Combined Total																		
6am-10am	39	52	6	2221	2946	17	345	458	21	22	29	10	500	664	16	47348	62803	17
10am-4pm	140	185	20	4749	6300	36	708	939	43	70	93	31	1077	1429	35	102146	135486	37
4pm-10pm	463	614	66	5247	6960	40	502	666	31	128	170	57	1233	1635	41	110695	146825	40
10pm-6am	64	85	9	961	1274	7	86	114	5	5	7	2	226	300	7	17613	23361	6
Total	706	936	100	13179	17480	100	1641	2177	100	225	299	100	3037	4028	100	277802	368475	100

Marshlands

	Daily Fuel Quantity			PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg/day	t/day	Use %	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Open fire																					
- Wood	3171	3.2	61	48	42	47	380	335	63	5	5	58	1	1	3	95	84	63	5390	4748	45
- Coal	1066	1.1	100	35	31	34	64	56	11	2	1	18	19	17	95	16	14	11	2985	2629	25
Pre 1989 Woodburner																					
- Wood	1023	1.0	20	13	12	13	105	92	17	1	1	16	0	0	1	26	23	17	1740	1532	15
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989-1992 (incl) Woodburner																					
- Wood	341	0.3	7	2	2	2	19	17	3	0	0	3	0	0	0	5	4	3	580	511	5
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post 1993 Woodburner																					
- Wood	682	0.7	13	4	4	4	32	28	5	0	0	5	0	0	1	8	7	5	1160	1021	10
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enclosed Coal Burner																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pot Belly																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incinerator																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Wood	5217	5.2		67	59	66	536	472	89	7	6	82	1	1	5	134	118	89	8869	7812	75
Total Coal	1066	1.1		35	31	34	64	56	11	2	1	18	19	17	95	16	14	11	2985	2629	25
Total Gas	274	0.3		0	0		0	0		1	0		0	0		0	0		685	604	
Total Oil	68	0.1		0	0		0	0		0	0		0	0		0	0		218	192	
Total (Wood and Coal only)	6283	6		102	90	100	600	529	100	9	8	100	20	18	100	150	132	100	11854	10441	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Light duty <3.5t petrol vehicles	11	10	23	2133	1879	85	531	468	50	1	1	3	604	532	84	72104	63511	69
Light duty <3.5t diesel vehicles	2	1	3	9	8	0	6	5	1	2	2	5	4	4	1	4302	3789	4
Light duty <3.5t LPG/CNG vehicles	0	0	0	6	5	0	13	11	1	0	0	0	12	10	2	2054	1809	2
Heavy duty >3.5t petrol vehicles	2	2	4	231	203	9	31	28	3	0	0	0	23	20	3	3567	3142	3
Heavy duty >3.5t diesel vehicles	32	28	69	74	65	3	481	424	45	36	31	88	59	52	8	22034	19408	21
Heavy duty >3.5t LPG/CNG vehicles	0	0	0	10	9	0	3	3	0	0	0	0	5	4	1	508	448	0
2&4 stroke petrol motorcycles	0	0	0	35	30	1	0	0	0	1	1	3	15	14	2	171	150	0
Total	46	41	100	2497	2200	100	1066	939	100	40	36	100	724	637	100	104741	92258	100

	PM10			CO			NOx			SOx			VOC			CO2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Part A																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Part B																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Part C																		
Combustion	2.8	2.4	100	1.7	1.5	100	6.7	5.9	100	12.5	11.0	100	0.2	0.2	7	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	2.6	2.3	93	0.0	0.0	0
Sub-total	2.8	2.4	100	1.7	1.5	100	6.7	5.9	100	12.5	11.0	100	2.8	2.5	100	0.0	0.0	0
Total																		
Combustion	2.8	2.4	100	1.7	1.5	100	6.7	5.9	100	12.5	11.0	100	0.2	0.2	7	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	2.6	2.3	93	0.0	0.0	0
Total	2.8	2.4	100	1.7	1.5	100	6.7	5.9	100	12.5	11.0	100	2.8	2.5	100	0.0	0.0	0

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	8	7	5	45	39	1	1	1	0	1	1	2	11	10	1	894	788	1
10am-4pm	26	23	17	187	165	6	3	2	0	2	2	3	47	41	5	3047	2684	3
4pm-10pm	63	56	42	329	290	11	5	4	0	16	14	22	82	72	9	7002	6167	6
10pm-6am	5	4	3	39	35	1	1	0	0	0	0	0	10	9	1	911	803	1
Total	102	90	68	600	529	19	9	8	1	20	18	28	150	132	17	11854	10441	10
Motor Vehicles																		
6am-10am	10	9	7	537	473	17	229	202	21	9	8	12	156	137	18	22516	19838	19
10am-4pm	20	18	13	1098	967	35	469	413	43	18	16	24	318	280	36	46056	40578	38
4pm-10pm	14	12	9	741	653	24	316	279	29	12	11	16	215	189	25	31090	27392	26
10pm-6am	2	2	1	121	107	4	52	46	5	2	2	3	35	31	4	5079	4475	4
Total	46	41	31	2497	2200	81	1066	939	99	40	36	55	724	638	83	104741	92283	87
Industry																		
6am-10am	1	1	0	0	0	0	2	1	0	3	3	4	1	1	0	1054	929	1
10am-4pm	2	2	1	1	1	0	4	4	0	8	7	11	2	2	0	2636	2322	2
4pm-10pm	0	0	0	0	0	0	1	1	0	2	1	2	0	0	0	527	464	0
10pm-6am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	3	2	2	2	2	0	7	6	1	12	11	17	3	2	0	4217	3715	3
Combined Total																		
6am-10am	18	16	12	582	513	19	231	204	21	13	12	18	167	147	19	24465	21549	20
10am-4pm	49	43	32	1287	1133	42	476	419	44	28	25	38	367	323	42	51738	45572	43
4pm-10pm	77	68	51	1070	943	35	322	284	30	30	26	41	297	262	34	38618	34016	32
10pm-6am	7	6	5	161	141	5	52	46	5	2	2	3	45	40	5	5990	5276	5
Total	151	133	100	3099	2730	100	1082	953	100	73	64	100	877	772	100	120812	106412	100

New Avonhead

	Daily Fuel Quantity			PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg/day	t/day	Use %	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Open fire																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pre 1989 Woodburner																					
- Wood	526	0.5	50	7	29	67	54	234	67	1	3	67	0.11	0.46	50	13	59	67	895	3889	50
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989-1992 (incl) Woodburner																					
- Wood	263	0.3	25	2	8	18	15	63	18	0	1	18	0.05	0.23	25	4	16	18	447	1945	25
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post 1993 Woodburner																					
- Wood	263	0.3	25	2	7	15	12	54	15	0	1	15	0.05	0.23	25	3	13	15	447	1945	25
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enclosed Coal Burner																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pot Belly																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incinerator																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Wood	1052	1.1		10	44	100	81	351	100	1	5	100	0.21	0.92	100	20	88	100	1789	7778	100
Total Coal	0	0.0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Gas	669	0.7		0	0		0	1		1	6		0.01	0.03		0	1		1671	7267	
Total Oil	0	0.0		0	0		0	0		0	0		0	0		0	0		0	0	
Total (Wood and Coal only)	1052	1		10	44	100	81	351	100	1	5	100	0.21	0.92	100	20	88	100	1789	7778	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Light duty <3.5t petrol vehicles	0	0	29	14	60	90	1	5	49	0	0	5	3	12	83	212	923	69
Light duty <3.5t diesel vehicles	0	0	3	0	0	0	0	0	1	0	0	5	0	0	0	13	55	4
Light duty <3.5t LPG/CNG vehicles	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	6	26	2
Heavy duty >3.5t petrol vehicles	0	0	3	1	4	6	0	0	2	0	0	0	0	0	3	11	46	3
Heavy duty >3.5t diesel vehicles	0	0	64	0	2	3	1	5	46	0	0	87	0	2	11	65	282	21
Heavy duty >3.5t LPG/CNG vehicles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	7	0
2&4 stroke petrol motorcycles	0	0	0	0	0	1	0	0	0	0	0	3	0	0	1	1	2	0
Total	0	1	100	15	66	100	2	11	100	0	1	100	3	15	100	308	1341	100

	PM10			CO			NOx			SOx			VOC			CO2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Part A																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Part B																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Part C																		
Combustion	0.9	3.7	100	0.7	2.9	100	2.6	11.5	100	4.6	19.9	100	0.1	0.4	100	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.9	3.7	100	0.7	2.9	100	2.6	11.5	100	4.6	19.9	100	0.1	0.4	100	0.0	0.0	0
Total																		
Combustion	0.9	3.7	100	0.7	2.9	100	2.6	11.5	100	4.6	19.9	100	0.1	0.4	100	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Total	0.9	3.7	100	0.7	2.9	100	2.6	11.5	100	4.6	19.9	100	0.1	0.4	100	0.0	0.0	0

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	0	1	2	2	9	2	0	0	0	0	0	0	1	2	2	75	324	2
10am-4pm	0	2	3	3	13	3	0	0	1	0	0	0	1	3	3	112	486	3
4pm-10pm	9	39	80	72	311	74	1	4	16	0	1	3	18	78	76	1454	6320	35
10pm-6am	1	2	5	4	18	4	0	0	1	0	0	0	1	4	4	149	648	4
Total	10	44	91•81•351		10	44	91•81•351	84	1	5•18•0	1	4	20	88	85	1789	7778	43
Motor Vehicles																		
6am-10am	0	0	0	3	11	3	0	2	7	0	0	0	1	2	2	53	228	1
10am-4pm	0	0	1	6	27	6	1	4	16	0	0	1	1	6	6	126	547	3
4pm-10pm	0	0	0	4	20	5	1	3	12	0	0	1	1	4	4	91	396	2
10pm-6am	0	0	0	2	8	2	0	1	5	0	0	0	0	2	2	39	170	1
Total	0	1	1	15	66	16	2	11	40	0	1	3	3	15	14	308	1341	7
Industry																		
6am-10am	0	1	2	0	1	0	1	3	11	1	5	23	0	0	0	507	2203	12
10am-4pm	1	2	5	0	2	0	2	7	26	3	12	58	0	0	0	1267	5507	31
4pm-10pm	0	0	1	0	0	0	0	1	5	1	2	12	0	0	0	253	1101	6
10pm-6am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1	4	8	1	3	1	3	11	42	5	20	93	0	0	0	2027	8811	49
Combined Total																		
6am-10am	0	2	4	5	21	5	1	5	18	1	5	24	1	5	5	634	2755	15
10am-4pm	1	4	9	10	42	10	3	12	43	3	13	60	2	10	9	1504	6540	36
4pm-10pm	9	40	82	76	331	79	2	9	33	1	3	16	19	82	80	1798	7817	44
10pm-6am	1	2	5	6	26	6	0	2	6	0	0	1	1	6	6	188	818	5
Total	11	48	100	97	420	100	6	27	100	5	21	100	24	103	100	4124	17929	100

New Brighton

	Daily Fuel Quantity			PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg/day	t/day	Use %	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Open fire																					
- Wood	19169	19.2	18	288	148	18	2300	1185	23	32	16	21	4	2	1	575	296	23	32588	16784	14
- Coal	7488	7.5	48	247	127	15	449	231	4	11	6	8	135	69	45	112	58	4	20966	10799	9
Pre 1989 Woodburner																					
- Wood	39537	39.5	37	506	261	31	4049	2085	40	56	29	38	8	4	3	1012	521	40	67212	34617	30
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989-1992 (incl) Woodburner																					
- Wood	21565	21.6	20	149	77	9	1190	613	12	16	8	11	4	2	1	298	153	12	36661	18882	16
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post 1993 Woodburner																					
- Wood	21565	21.6	20	127	66	8	1018	524	10	14	7	10	4	2	1	254	131	10	36661	18882	16
- Coal	2304	2.3	15	30	15	2	54	28	1	1	1	1	41	21	14	14	7	1	6451	3323	3
Enclosed Coal Burner																					
- Wood	5530	5.5	5	79	41	5	633	326	6	9	4	6	1	1	0	158	81	6	9400	4842	4
- Coal	5760	5.8	37	181	93	11	329	170	3	8	4	6	104	53	34	82	42	3	16128	8307	7
Pot Belly																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incinerator																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Wood	107366	107.4		1149	592	71	9190	4733	92	126	65	86	21	11	7	2297	1183	92	18252	94006	81
Total Coal	15552	15.6		458	236	29	833	429	8	21	11	14	280	144	93	208	107	8	43546	22428	19
Total Gas	13478	13.5		1	1		5	3		27	14		0	0		3	1		33696	17355	
Total Oil	823	0.8		1	1		0	0		2	1		3	2		0	0		2633	1356	
Total (Wood and Coal only)	122918	123		1607	828	100	10023	5162	100	147	76	100	301	155	100	2506	1291	100	22606	11643	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Light duty <3.5t petrol vehicles	24	13	29	7446	3835	90	694	357	49	3	2	5	1539	792	83	118424	60993	69
Light duty <3.5t diesel vehicles	3	1	3	15	8	0	10	5	1	4	2	5	7	4	0	7065	3639	4
Light duty <3.5t LPG/CNG vehicles	0	0	0	16	8	0	21	11	1	0	0	0	20	11	1	3373	1737	2
Heavy duty >3.5t petrol vehicles	3	1	3	477	246	6	32	17	2	0	0	0	48	25	3	5859	3018	3
Heavy duty >3.5t diesel vehicles	55	28	65	248	128	3	643	331	46	61	31	87	198	102	11	36189	18639	21
Heavy duty >3.5t LPG/CNG vehicles	0	0	0	16	8	0	5	3	0	0	0	0	8	4	0	835	430	0
2&4 stroke petrol motorcycles	0	0	0	57	29	1	0	0	0	2	1	3	25	13	1	280	144	0
Total	85	44	100	8275	4262	100	1404	723	100	70	36	100	1845	950	100	172026	88600	100

	PM10			CO			NOx			SOx			VOC			CO2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Part A																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Part B																		
Combustion	1.6	0.8	20	1.0	0.5	15	3.7	1.9	16	6.9	3.6	17	0.1	0.1	0	2258.4	1163.2	100
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	12.4	6.4	36	0.0	0.0	0
Sub-total	1.6	0.8	20	1.0	0.5	15	3.7	1.9	16	6.9	3.6	17	12.5	6.5	37	2258.4	1163.2	100
Part C																		
Combustion	6.4	3.3	80	5.6	2.9	85	20.2	10.4	84	34.2	17.6	83	0.9	0.5	3	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	20.8	10.7	61	0.0	0.0	0
Sub-total	6.4	3.3	80	5.6	2.9	85	20.2	10.4	84	34.2	17.6	83	21.7	11.2	63	0.0	0.0	0
Total																		
Combustion	7.9	4.1	100	6.6	3.4	100	23.9	12.3	100	41.1	21.2	100	1.0	0.5	3	2258.4	1163.2	100
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	33.2	17.1	97	0.0	0.0	0
Total	7.9	4.1	100	6.6	3.4	100	23.9	12.3	100	41.1	21.2	100	34.2	17.6	100	2258.4	1163.2	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	133	68	8	746	384	4	11	6	1	30	16	7	186	96	4	16887	8697	4
10am-4pm	124	64	7	712	367	4	11	6	1	28	14	7	178	92	4	18908	9738	5
4pm-10pm	1026	528	60	6604	3401	36	96	49	6	182	94	44	1651	850	38	148882	76680	36
10pm-6am	325	167	19	1962	1010	11	29	15	2	61	32	15	490	253	11	41392	21319	10
Total	1607	828	95	10023	5162	55	147	76	9	301	155	73	2506	1291	57	226068	116434	54
Motor Vehicles																		
6am-10am	18	9	1	1798	926	10	294	151	19	15	8	4	398	205	9	36425	18757	9
10am-4pm	37	19	2	3700	1905	20	604	311	38	31	16	7	819	422	19	74950	38594	18
4pm-10pm	26	13	2	2573	1325	14	420	216	27	21	11	5	570	293	13	52125	26841	12
10pm-6am	4	2	0	203	105	1	87	45	6	3	2	1	59	30	1	8525	4390	2
Total	85	44	5	8275	4261	45	1404	723	89	70	36	17	1845	950	42	172026	88582	41
Industry																		
6am-10am	2	1	0	2	1	0	6	3	0	10	5	2	9	4	0	4760	2452	1
10am-4pm	5	3	0	4	2	0	15	8	1	26	13	6	21	11	0	11900	6129	3
4pm-10pm	1	1	0	1	0	0	3	2	0	5	3	1	4	2	0	2380	1226	1
10pm-6am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	8	4	0	7	3	0	24	12	2	41	21	10	34	18	1	19040	9806	5
Combined Total																		
6am-10am	153	79	9	2546	1311	14	311	160	20	55	29	13	593	305	14	58072	29910	14
10am-4pm	166	86	10	4416	2275	24	630	324	40	84	43	20	1018	524	23	105758	54471	25
4pm-10pm	1052	542	62	9178	4727	50	519	267	33	208	107	51	2225	1146	51	203387	104754	49
10pm-6am	328	169	19	2165	1115	12	116	60	7	65	33	16	549	283	13	49918	25710	12
Total	1700	876	100	18305	9428	100	1575	811	100	412	212	100	4385	2259	100	417135	214844	100

Opawa/Woolston

	Daily Fuel Quantity			PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg/day	t/day	Use %	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Open fire																					
- Wood	7167	7.2	23	108	135	25	860	1077	30	12	15	28	1	2	2	215	269	30	12185	15263	20
- Coal	2365	2.4	79	78	98	18	142	178	5	4	4	9	43	53	71	35	44	5	6623	8296	11
Pre 1989 Woodburner																					
- Wood	12175	12.2	39	156	195	36	1247	1562	43	17	21	41	2	3	4	312	390	43	20697	25926	34
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989-1992 (incl) Woodburner																					
- Wood	5831	5.8	19	40	50	9	322	403	11	4	6	11	1	1	2	80	101	11	9912	12417	16
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post 1993 Woodburner																					
- Wood	5831	5.8	19	34	43	8	275	345	10	4	5	9	1	1	2	69	86	10	9912	12417	16
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enclosed Coal Burner																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	613	0.6	21	19	24	4	35	44	1	1	1	2	11	14	18	9	11	1	1717	2151	3
Pot Belly																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incinerator																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Wood	31003	31.0		338	423	78	2704	3387	94	37	47	89	6	8	10	676	847	94	52706	66023	86
Total Coal	2978	3.0		97	122	22	177	222	6	4	6	11	54	67	90	44	55	6	8340	10447	14
Total Gas	838	0.8		0	0		0	0		2	2		0	0		0	0		2096	2626	
Total Oil	225	0.2		0	0		0	0		0	1		1	1		0	0		721	903	
Total (Wood and Coal only)	33982	34		435	545	100	2881	3609	100	42	52	100	60	75	100	720	902	100	61045	76469	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Light duty <3.5t petrol vehicles	24	29	29	7168	8979	90	667	836	49	3	4	5	1481	1855	83	113925	142709	69
Light duty <3.5t diesel vehicles	3	3	3	14	18	0	9	12	1	3	4	5	7	9	0	6797	8514	4
Light duty <3.5t LPG/CNG vehicles	0	0	0	16	20	0	20	25	1	0	0	0	20	25	1	3245	4065	2
Heavy duty >3.5t petrol vehicles	3	3	3	459	575	6	31	39	2	0	0	0	46	58	3	5637	7061	3
Heavy duty >3.5t diesel vehicles	53	66	65	239	299	3	618	774	46	58	73	87	190	239	11	34814	43610	21
Heavy duty >3.5t LPG/CNG vehicles	0	0	0	16	20	0	5	6	0	0	0	0	8	10	0	803	1006	0
2&4 stroke petrol motorcycles	0	0	0	55	68	1	0	1	0	2	2	3	24	31	1	270	338	0
Total	82	102	100	7966	9978	100	1351	1692	100	67	84	100	1776	2225	100	165490	207303	100

	PM10			CO			NOx			SOx			VOC			CO2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Part A																		
Combustion	1.2	1.5	1	2.7	3.3	7	11.7	14.6	8	16.7	20.9	6	0.8	0.9	1	13460.8	16861.7	28
Other Processes	100.0	125.3	62	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	15.6	19.5	23	0.0	0.0	0
Sub-total	101.2	126.7	62	2.7	3.3	7	11.7	14.6	8	16.7	20.9	6	16.3	20.4	24	13460.8	16861.7	28
Part B																		
Combustion	47.7	59.7	29	24.0	30.1	60	87.5	109.6	58	177.4	222.2	64	1.2	1.6	2	34680.9	43443.0	72
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	6.5	8.2	10	0.0	0.0	0
Sub-total	47.7	59.8	29	24.0	30.1	60	87.5	109.6	58	177.4	222.2	64	7.8	9.7	11	34680.9	43443.0	72
Part C																		
Combustion	13.2	16.5	8	13.5	16.9	34	50.4	63.1	34	81.9	102.6	30	2.5	3.1	4	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	41.6	52.1	61	0.0	0.0	0
Sub-total	13.2	16.5	8	13.5	16.9	34	50.4	63.1	34	81.9	102.6	30	44.1	55.2	65	0.0	0.0	0
Total																		
Combustion	62.1	77.8	38	40.2	50.3	100	149.5	187.3	100	276.0	345.7	100	4.5	5.6	7	48141.7	60304.7	100
Other Processes	100.0	125.3	62	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	63.7	79.8	93	0.0	0.0	0
Total	162.1	203.1	100	40.2	50.3	100	149.5	187.3	100	276.0	345.7	100	68.2	85.4	100	48141.7	60304.7	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	24	30	4	192	240	2	3	3	0	1	1	0	48	60	2	4421	5538	1
10am-4pm	49	62	7	360	451	3	5	6	0	4	5	1	90	113	4	7861	9848	2
4pm-10pm	294	368	43	1832	2294	17	27	34	2	50	62	12	458	574	18	38989	48840	12
10pm-6am	68	85	10	498	623	5	7	9	0	5	7	1	124	156	5	9774	12243	3
Total	435	545	64	2881	3609	26	42	52	3	60	75	15	720	902	28	61045	76469	19
Motor Vehicles																		
6am-10am	18	22	3	1763	2210	16	288	361	19	15	18	4	390	489	15	35717	44758	11
10am-4pm	37	46	5	3659	4585	34	597	748	39	30	38	7	810	1015	32	74118	92880	23
4pm-10pm	24	30	3	2352	2948	22	384	481	25	19	24	5	521	652	20	47643	59704	15
10pm-6am	4	4	1	191	239	2	82	102	5	3	4	1	55	69	2	8012	10040	2
Total	82	102	12	7966	9982	73	1351	1692	88	67	84	17	1776	2226	69	165490	207381	52
Industry																		
6am-10am	28	35	4	8	10	0	30	37	2	54	67	13	17	21	1	19707	24686	6
10am-4pm	46	58	7	15	19	0	57	72	4	102	128	25	40	50	2	41386	51842	13
4pm-10pm	39	49	6	8	10	0	31	39	2	59	73	15	10	12	0	17689	22158	6
10pm-6am	49	61	7	9	11	0	32	40	2	62	77	15	2	3	0	15273	19132	5
Total	162	203	24	40	50	0	150	187	10	276	346	68	68	85	3	94055	117818	29
Combined Total																		
6am-10am	70	88	10	1963	2459	18	320	401	21	69	86	17	455	570	18	59845	74965	19
10am-4pm	132	166	19	4035	5054	37	660	826	43	136	171	34	940	1177	37	123365	154533	38
4pm-10pm	356	446	52	4192	5251	39	442	553	29	128	160	32	988	1238	39	104322	130678	33
10pm-6am	121	151	18	697	873	6	120	150	8	70	88	17	182	228	7	33059	41411	10
Total	679	851	100	10887	13637	100	1542	1931	100	403	505	100	2564	3212	100	320590	401587	100

Parklands

	Daily Fuel Quantity			PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg/day	t/day	Use %	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Open fire																					
- Wood	405	0.4	6	6	19	7	49	156	9	1	2	8	0	0	0	12	39	9	689	2207	5
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pre 1989 Woodburner																					
- Wood	2515	2.5	35	32	103	35	258	825	45	4	11	42	1	2	3	64	206	45	4276	13696	29
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989-1992 (incl) Woodburner																					
- Wood	2096	2.1	29	14	46	16	116	371	20	2	5	19	0	1	2	29	93	20	3563	11413	25
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post 1993 Woodburner																					
- Wood	2096	2.1	29	12	40	13	99	317	17	1	4	16	0	1	2	25	79	17	3563	11413	25
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enclosed Coal Burner																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	873	0.9	100	27	88	30	50	160	9	1	4	15	16	50	92	12	40	9	2445	7833	17
Pot Belly																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incinerator																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Wood	7112	7.1		65	209	70	521	1668	91	7	23	85	1	5	8	130	417	91	12091	38729	83
Total Coal	873	0.9		27	88	30	50	160	9	1	4	15	16	50	92	12	40	9	2445	7833	17
Total Gas	2129	2.1		0	1		1	3		4	14		0	0		0	1		5324	17052	
Total Oil	0	0.0		0	0		0	0		0	0		0	0		0	0		0	0	
Total (Wood and Coal only)	7986	8		93	297	100	571	1828	100	8	27	100	17	55	100	143	457	100	14536	46561	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Light duty <3.5t petrol vehicles	3	11	29	1015	3252	90	94	302	49	0	2	5	210	672	83	16127	51656	69
Light duty <3.5t diesel vehicles	0	1	3	2	7	0	1	4	1	0	2	5	1	3	0	962	3082	4
Light duty <3.5t LPG/CNG vehicles	0	0	0	2	7	0	3	9	1	0	0	0	3	9	1	459	1471	2
Heavy duty >3.5t petrol vehicles	0	1	3	65	208	6	4	14	2	0	0	0	7	21	3	798	2556	3
Heavy duty >3.5t diesel vehicles	7	24	65	34	108	3	87	280	46	8	27	87	27	86	11	4928	15785	21
Heavy duty >3.5t LPG/CNG vehicles	0	0	0	2	7	0	1	2	0	0	0	0	1	4	0	114	364	0
2&4 stroke petrol motorcycles	0	0	0	8	25	1	0	0	0	0	1	3	3	11	1	38	122	0
Total	12	37	100	1128	3614	100	191	612	100	10	30	100	252	806	100	23427	75037	100

	PM10			CO			NOx			SOx			VOC			CO2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Part A																		
Combustion	32.2	103.1	79	16.1	51.7	95	58.1	186.0	86	112.7	360.9	95	0.4	1.3	82	15453.5	49498.5	100
Other Processes	6.8	21.8	17	0.0	0.0	0	6.4	20.4	9	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	39.0	124.9	96	16.1	51.7	95	64.5	206.4	95	112.7	360.9	95	0.4	1.3	82	15453.5	49498.5	100
Part B																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Part C																		
Combustion	1.5	4.9	4	0.9	2.9	5	3.4	11.0	5	6.5	21.0	5	0.1	0.3	18	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	1.5	4.9	4	0.9	2.9	5	3.4	11.0	5	6.5	21.0	5	0.1	0.3	18	0.0	0.0	0
Total																		
Combustion	33.7	108.0	83	17.0	54.6	100	61.5	197.0	91	119.2	381.9	100	0.5	1.5	100	15453.5	49498.5	100
Other Processes	6.8	21.8	17	0.0	0.0	0	6.4	20.4	9	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Total	40.5	129.8	100	17.0	54.6	100	67.9	217.4	100	119.2	381.9	100	0.5	1.5	100	15453.5	49498.5	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	15	46	10	74	236	4	1	4	0	4	13	3	18	59	5	2274	7284	4
10am-4pm	20	65	14	99	316	6	2	5	1	6	20	4	25	79	6	3055	9785	6
4pm-10pm	53	170	37	362	1160	21	5	17	2	7	22	5	91	290	23	8020	25688	14
10pm-6am	5	15	3	36	116	2	0	2	0	0	0	0	9	29	2	1188	3804	2
Total	93	297	64	571	1828	33	8	27	3	17	55	12	143	457	36	14536	46561	26
Motor Vehicles																		
6am-10am	2	8	2	247	790	14	40	129	15	2	7	1	55	175	14	4994	16008	9
10am-4pm	5	16	3	503	1611	29	82	263	31	4	13	3	111	357	28	10180	32627	18
4pm-10pm	4	11	2	353	1130	21	58	185	22	3	9	2	78	250	20	7144	22898	13
10pm-6am	0	2	0	26	85	2	11	36	4	0	1	0	8	25	2	1108	3551	2
Total	12	37	8	1128	3616	66	191	613	72	10	31	7	252	806	64	23427	75085	42
Industry																		
6am-10am	7	24	5	3	9	0	12	39	5	20	66	14	0	0	0	3076	9854	6
10am-4pm	12	40	9	5	15	0	20	64	7	32	103	22	0	0	0	5108	16362	9
4pm-10pm	10	32	7	4	13	0	17	53	6	29	93	20	0	0	0	4105	13150	7
10pm-6am	11	34	7	5	17	0	19	62	7	38	120	26	0	0	0	5099	16333	9
Total	41	130	28	17	55	1	68	217	25	119	382	82	0	2	0	17389	55698	31
Combined Total																		
6am-10am	24	78	17	323	1035	19	54	172	20	27	85	18	73	234	19	10345	33135	19
10am-4pm	38	121	26	606	1941	35	103	331	39	43	136	29	136	436	34	18343	58753	33
4pm-10pm	67	214	46	719	2303	42	79	254	30	39	124	26	169	540	43	19269	61721	35
10pm-6am	16	50	11	68	218	4	31	100	12	38	122	26	17	54	4	7395	23687	13
Total	145	463	100	1716	5497	100	267	857	100	146	467	100	395	1264	100	55352	177296	100

Racecourse

	Daily Fuel Quantity			PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg/day	t/day	Use %	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Open fire																					
- Wood	925	0.9	19	14	56	12	111	449	21	2	6	18	0	1	1	28	112	21	1572	6356	11
- Coal	1248	1.2	64	41	166	36	75	303	14	2	8	22	22	91	62	19	76	14	3493	14120	26
Pre 1989 Woodburner																					
- Wood	1652	1.7	34	21	85	18	169	684	32	2	9	27	0	1	1	42	171	32	2808	11351	21
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989-1992 (incl) Woodburner																					
- Wood	826	0.8	17	6	23	5	46	184	9	1	3	7	0	1	0	11	46	9	1404	5676	10
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post 1993 Woodburner																					
- Wood	1032	1.0	21	6	25	5	49	197	9	1	3	8	0	1	1	12	49	9	1755	7095	13
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enclosed Coal Burner																					
- Wood	215	0.2	4	3	12	3	25	99	5	0	1	4	0	0	0	6	25	5	366	1478	3
- Coal	717	0.7	36	23	91	19	41	166	8	1	4	12	13	52	36	10	41	8	2008	8115	15
Pot Belly																					
- Wood	158	0.2	3	2	9	2	18	73	3	0	1	3	0	0	0	5	18	3	268	1084	2
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incinerator																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Wood	4808	4.8		52	211	45	417	1686	78	6	23	66	1	4	3	104	422	78	8174	33039	60
Total Coal	1965	2.0		64	258	55	116	468	22	3	12	34	35	143	97	29	117	22	5501	22235	40
Total Gas	176	0.2		0	0		0	0		0	1		0	0		0	0		440	1780	
Total Oil	37	0.0		0	0		0	0		0	0		0	1		0	0		118	477	
Total (Wood and Coal only)	6773	7		116	468	100	533	2154	100	9	35	100	36	147	100	133	539	100	13675	55274	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Light duty <3.5t petrol vehicles	1	6	27	199	803	82	95	384	62	0	1	4	62	251	83	9410	38035	69
Light duty <3.5t diesel vehicles	0	1	4	1	5	0	1	3	1	0	1	6	1	2	1	561	2269	4
Light duty <3.5t LPG/CNG vehicles	0	0	0	1	2	0	2	9	1	0	0	0	2	6	2	268	1083	2
Heavy duty >3.5t petrol vehicles	0	1	6	27	111	11	4	17	3	0	0	0	2	8	3	466	1882	3
Heavy duty >3.5t diesel vehicles	3	13	63	8	32	3	50	204	33	4	17	87	6	25	8	2875	11623	21
Heavy duty >3.5t LPG/CNG vehicles	0	0	0	1	5	1	0	2	0	0	0	0	1	3	1	66	268	0
2&4 stroke petrol motorcycles	0	0	0	5	18	2	0	0	0	0	1	3	2	8	3	22	90	0
Total	5	21	100	241	976	100	153	618	100	5	20	100	75	302	100	13669	55250	100

	PM10			CO			NOx			SOx			VOC			CO2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Part A																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Part B																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Part C																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Total																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	6	25	5	38	153	5	1	2	0	1	5	3	9	38	5	915	3699	3
10am-4pm	28	113	23	119	482	15	2	8	1	10	39	23	30	121	14	3182	12863	12
4pm-10pm	64	260	53	289	1168	37	5	19	3	21	85	51	72	292	35	7556	30542	28
10pm-6am	17	69	14	87	351	11	1	5	1	5	19	11	22	88	10	2021	8170	7
Total	116	468	96	533	2154	69	9	35	5	36	147	88	133	539	64	13675	55274	50
Motor Vehicles																		
6am-10am	1	4	1	43	176	6	28	111	17	1	4	2	13	54	6	2459	9956	9
10am-4pm	2	9	2	102	411	13	64	260	40	2	8	5	31	127	15	5749	23274	21
4pm-10pm	2	6	1	73	297	9	46	188	29	1	6	4	23	92	11	4152	16808	15
10pm-6am	1	2	0	23	94	3	15	59	9	0	2	1	7	29	3	1310	5302	5
Total	5	21	4	241	977	31	153	619	95	5	20	12	75	303	36	13669	55340	50
Industry																		
6am-10am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10am-4pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4pm-10pm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10pm-6am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Combined Total																		
6am-10am	7	29	6	81	329	10	28	113	17	2	8	5	23	93	11	3374	13638	12
10am-4pm	30	122	25	221	892	29	66	268	41	12	47	28	61	248	29	8931	36099	33
4pm-10pm	66	267	55	362	1465	47	51	207	32	22	91	54	95	384	46	11708	47322	43
10pm-6am	18	71	15	110	444	14	16	65	10	5	20	12	29	117	14	3331	13463	12
Total	121	490	100	774	3130	100	162	653	100	41	166	100	208	841	100	27344	110522	100

Redwood

	Daily Fuel Quantity			PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg/day	t/day	Use %	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Open fire																					
- Wood	11461	11.5	61	172	229	47	1375	1830	63	19	25	58	2	3	3	344	458	63	19484	25927	45
- Coal	3853	3.9	100	127	169	34	231	308	11	6	8	18	69	92	95	58	77	11	10789	14356	25
Pre 1989 Woodburner																					
- Wood	3699	3.7	20	47	63	13	379	504	17	5	7	16	1	1	1	95	126	17	6288	8368	15
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989-1992 (incl) Woodburner																					
- Wood	1233	1.2	7	9	11	2	68	91	3	1	1	3	0	0	0	17	23	3	2096	2789	5
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post 1993 Woodburner																					
- Wood	2466	2.5	13	15	19	4	116	155	5	2	2	5	0	1	1	29	39	5	4192	5578	10
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enclosed Coal Burner																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pot Belly																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incinerator																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Wood	18859	18.9		242	322	66	1939	2580	89	27	35	82	4	5	5	485	645	89	32060	42662	75
Total Coal	3853	3.9		127	169	34	231	308	11	6	8	18	69	92	95	58	77	11	10789	14356	25
Total Gas	991	1.0		0	0		0	1		2	3		0	0		0	0		2477	3296	
Total Oil	246	0.2		0	0		0	0		1	1		1	1		0	0		787	1048	
Total (Wood and Coal only)	22712	23		369	492	100	2170	2887	100	32	43	100	73	97	100	542	722	100	42849	57018	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Light duty <3.5t petrol vehicles	14	18	27	3872	5153	89	444	591	50	2	3	5	841	1120	83	71187	94727	69
Light duty <3.5t diesel vehicles	2	2	3	9	12	0	6	8	1	2	3	5	4	6	0	4247	5652	4
Light duty <3.5t LPG/CNG vehicles	0	0	0	9	12	0	12	17	1	0	0	0	12	16	1	2028	2698	2
Heavy duty >3.5t petrol vehicles	2	2	3	272	362	6	22	30	2	0	0	0	27	36	3	3522	4687	3
Heavy duty >3.5t diesel vehicles	33	43	66	130	173	3	409	544	46	36	48	87	104	138	10	21754	28947	21
Heavy duty >3.5t LPG/CNG vehicles	0	0	0	10	13	0	3	4	0	0	0	0	5	7	0	502	668	0
2&4 stroke petrol motorcycles	0	0	0	34	45	1	0	0	0	1	1	3	15	20	2	169	224	0
Total	50	66	100	4335	5769	100	897	1194	100	41	55	100	1009	1342	100	103409	137603	100

	PM10			CO			NOx			SOx			VOC			CO2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Part A																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Part B																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Part C																		
Combustion	8.9	11.9	100	5.6	7.5	100	18.7	24.9	100	35.7	47.5	100	0.5	0.7	6	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	7.8	10.4	94	0.0	0.0	0
Sub-total	8.9	11.9	100	5.6	7.5	100	18.7	24.9	100	35.7	47.5	100	8.3	11.1	100	0.0	0.0	0
Total																		
Combustion	8.9	11.9	100	5.6	7.5	100	18.7	24.9	100	35.7	47.5	100	0.5	0.7	6	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	7.8	10.4	94	0.0	0.0	0
Total	8.9	11.9	100	5.6	7.5	100	18.7	24.9	100	35.7	47.5	100	8.3	11.1	100	0.0	0.0	0

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	27	36	6	162	215	3	2	3	1	5	7	4	40	54	4	3232	4301	3
10am-4pm	96	127	22	677	902	15	10	13	2	9	12	7	169	225	15	11013	14655	11
4pm-10pm	229	304	53	1188	1581	26	18	25	4	59	78	45	297	395	27	25310	33679	25
10pm-6am	18	24	4	142	190	3	2	3	0	0	1	0	36	47	3	3294	4383	3
Total	369	492	86	2170	2887	47	32	43	7	73	97	57	542	722	50	42849	57018	41
Motor Vehicles																		
6am-10am	11	15	3	542	721	12	88	118	20	4	6	3	120	160	11	10979	14600	11
10am-4pm	23	30	5	1135	1510	24	185	246	41	9	12	7	251	334	23	23000	30585	22
4pm-10pm	13	18	3	664	883	14	108	144	24	5	7	4	147	195	13	13452	17889	13
10pm-6am	3	3	1	118	157	3	19	26	4	1	1	1	26	35	2	2388	3176	2
Total	50	66	12	2460	3271	53	401	534	89	20	27	16	544	724	50	49819	66249	48
Industry																		
6am-10am	2	3	1	1	2	0	5	6	1	9	12	7	2	3	0	2648	3524	3
10am-4pm	6	7	1	4	5	0	12	16	3	22	30	17	5	7	0	6621	8810	6
4pm-10pm	1	1	0	1	1	0	2	3	1	4	6	3	1	1	0	1324	1762	1
10pm-6am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	9	12	2	6	7	0	19	25	4	36	48	28	8	11	1	10593	14095	10
Combined Total																		
6am-10am	41	54	10	705	938	15	96	127	21	19	25	15	162	216	15	16860	22433	16
10am-4pm	124	165	29	1816	2417	39	207	275	46	40	54	31	426	567	39	40634	54067	39
4pm-10pm	243	324	57	1853	2466	40	129	172	29	68	91	53	445	592	41	40086	53338	39
10pm-6am	20	27	5	260	346	6	21	28	5	1	2	1	62	82	6	5682	7560	6
Total	428	570	100	4635	6167	100	453	602	100	129	172	100	1095	1457	100	103262	137399	100

Riccarton

	Daily Fuel Quantity			PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg/day	t/day	Use %	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Open fire																					
- Wood	4147	4.1	41	62	178	25	498	1426	41	7	20	36	1	2	1	124	356	41	7050	20200	25
- Coal	2316	2.3	58	76	219	31	139	398	11	3	10	18	42	119	57	35	100	11	6486	18583	23
Pre 1989 Woodburner																					
- Wood	3706	3.7	37	47	136	19	380	1087	31	5	15	27	1	2	1	95	272	31	6300	18053	22
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989-1992 (incl) Woodburner																					
- Wood	741	0.7	7	5	15	2	41	117	3	1	2	3	0	0	0	10	29	3	1260	3611	4
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post 1993 Woodburner																					
- Wood	1482	1.5	15	9	25	4	70	200	6	1	3	5	0	1	0	17	50	6	2520	7221	9
- Coal	331	0.3	8	4	12	2	8	22	1	0	1	1	6	17	8	2	6	1	927	2655	3
Enclosed Coal Burner																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	1324	1.3	33	42	119	17	76	217	6	2	5	10	24	68	32	19	54	6	3706	10619	13
Pot Belly																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incinerator																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Wood	10077	10.1		124	354	50	988	2831	82	14	39	71	2	6	3	247	708	82	17130	49084	61
Total Coal	3971	4.0		122	351	50	222	638	18	6	16	29	71	205	97	56	159	18	11118	31857	39
Total Gas	662	0.7		0	0		0	1		1	4		0	0		0	0		1655	4741	
Total Oil	170	0.2		0	1		0	0		0	1		1	2		0	0		545	1560	
Total (Wood and Coal only)	14047	14		246	705	100	1211	3468	100	19	55	100	73	211	100	303	867	100	28248	80941	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Light duty <3.5t petrol vehicles	18	53	29	5653	16198	90	506	1449	49	3	8	5	1158	3318	83	87495	250702	69
Light duty <3.5t diesel vehicles	2	6	3	11	32	0	7	21	1	3	8	5	5	15	0	5220	14957	4
Light duty <3.5t LPG/CNG vehicles	0	0	0	12	35	0	15	44	1	0	0	0	15	43	1	2492	7141	2
Heavy duty >3.5t petrol vehicles	2	6	3	356	1021	6	23	66	2	0	0	0	36	102	3	4329	12404	3
Heavy duty >3.5t diesel vehicles	41	116	64	188	539	3	469	1345	46	45	129	87	150	430	11	26737	76611	21
Heavy duty >3.5t LPG/CNG vehicles	0	0	0	12	34	0	4	10	0	0	0	0	6	18	0	617	1768	0
2&4 stroke petrol motorcycles	0	0	0	42	120	1	0	1	0	1	4	3	19	54	1	207	594	0
Total	63	181	100	6275	17979	100	1024	2935	100	52	148	100	1389	3979	100	127098	364176	100

	PM10			CO			NOx			SOx			VOC			CO2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Part A																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Part B																		
Combustion	0.1	0.3	2	0.2	0.6	6	0.9	2.7	7	1.3	3.8	6	0.1	0.2	3	1077.6	3087.3	100
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	1.6	4.6	82	0.0	0.0	0
Sub-total	0.1	0.3	2	0.2	0.6	6	0.9	2.7	7	1.3	3.8	6	1.7	4.8	85	1077.6	3087.3	100
Part C																		
Combustion	5.4	15.6	98	3.2	9.1	94	12.0	34.3	93	23.0	65.8	94	0.3	0.9	15	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	5.4	15.6	98	3.2	9.1	94	12.0	34.3	93	23.0	65.8	94	0.3	0.9	15	0.0	0.0	0
Total																		
Combustion	5.5	15.8	100	3.4	9.7	100	12.9	37.0	100	24.3	69.7	100	0.4	1.0	18	1077.6	3087.3	100
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	1.6	4.6	82	0.0	0.0	0
Total	5.5	15.8	100	3.4	9.7	100	12.9	37.0	100	24.3	69.7	100	2.0	5.6	100	1077.6	3087.3	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	15	43	5	42	121	1	1	2	0	7	20	5	11	30	1	1531	4387	1
10am-4pm	32	92	10	129	369	2	2	6	0	14	39	9	32	92	2	4397	12598	3
4pm-10pm	185	530	59	1014	2905	14	15	44	1	45	129	30	254	726	15	21085	60417	13
10pm-6am	14	40	4	25	72	0	1	2	0	8	23	5	6	18	0	1235	3540	1
Total	246	705	78	1211	3468	16	19	55	2	73	211	49	303	867	18	28248	80941	17
Motor Vehicles																		
6am-10am	14	40	4	1386	3970	19	226	648	21	11	33	8	307	879	18	28066	80420	17
10am-4pm	29	83	9	2866	8213	38	468	1340	44	24	68	16	634	1818	37	58055	166347	36
4pm-10pm	17	50	5	1718	4922	23	280	803	27	14	41	9	380	1089	22	34793	99693	21
10pm-6am	3	9	1	305	875	4	50	143	5	3	7	2	68	194	4	6183	17717	4
Total	63	181	20	6275	17979	84	1024	2935	97	52	148	35	1389	3979	82	127098	364176	78
Industry																		
6am-10am	1	4	0	1	2	0	3	9	0	6	17	4	0	1	0	1927	5521	1
10am-4pm	3	10	1	2	6	0	8	23	1	15	43	10	1	3	0	4683	13417	3
4pm-10pm	1	2	0	0	1	0	2	5	0	3	9	2	0	1	0	1098	3146	1
10pm-6am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	6	16	2	3	10	0	13	37	1	24	70	16	2	6	0	7709	22085	5
Combined Total																		
6am-10am	30	87	10	1429	4094	19	230	660	22	25	70	16	318	910	19	31525	90328	19
10am-4pm	64	185	20	2997	8588	40	478	1370	45	52	150	35	668	1913	39	67135	192364	41
4pm-10pm	203	582	65	2732	7829	36	298	853	28	62	178	42	634	1817	37	56976	163256	35
10pm-6am	17	49	5	330	947	4	50	145	5	10	30	7	74	212	4	7419	21257	5
Total	315	901	100	7489	21457	100	1056	3027	100	150	429	100	1693	4852	100	163054	467205	100

Shirley

	Daily Fuel Quantity			PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg/day	t/day	Use %	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Open fire																					
- Wood	2860	2.9	10	43	75	11	343	600	13	5	8	13	1	1	1	86	150	13	4863	8497	9
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pre 1989 Woodburner																					
- Wood	12122	12.1	43	155	271	40	1241	2169	48	17	30	46	2	4	5	310	542	48	20607	36007	38
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989-1992 (incl) Woodburner																					
- Wood	4959	5.0	18	34	60	9	274	478	11	4	7	10	1	2	2	68	120	11	8430	14730	15
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post 1993 Woodburner																					
- Wood	5510	5.5	20	33	57	8	260	454	10	4	6	10	1	2	2	65	114	10	9367	16367	17
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enclosed Coal Burner																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	644	0.6	25	20	35	5	37	64	1	1	2	2	12	20	22	9	16	1	1802	3149	3
Pot Belly																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incinerator																					
- Wood	2418	2.4	9	38	66	10	302	527	12	4	7	11	0	1	1	75	132	12	4110	7182	8
- Coal	1931	1.9	75	66	116	17	120	211	5	3	5	8	35	61	67	30	53	5	5407	9448	10
Total Wood	27869	27.9		303	529	78	2420	4229	94	33	58	89	6	10	11	605	1057	94	47377	82783	87
Total Coal	2575	2.6		87	151	22	157	275	6	4	7	11	46	81	89	39	69	6	7209	12597	13
Total Gas	2639	2.6		0	0		1	2		5	9		0	0		1	1		6598	11528	
Total Oil	0	0.0		0	0		0	0		0	0		0	0		0	0		0	0	
Total (Wood and Coal only)	30443	30		389	680	100	2577	4504	100	37	65	100	52	91	100	644	1126	100	54586	95380	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Light duty <3.5t petrol vehicles	12	20	29	3567	6233	90	319	557	49	2	3	5	731	1277	83	55206	96464	69
Light duty <3.5t diesel vehicles	1	2	3	7	12	0	5	8	1	2	3	5	3	6	0	3294	5755	4
Light duty <3.5t LPG/CNG vehicles	0	0	0	8	13	0	10	17	1	0	0	0	10	17	1	1573	2748	2
Heavy duty >3.5t petrol vehicles	1	2	3	225	393	6	14	25	2	0	0	0	22	39	3	2731	4773	3
Heavy duty >3.5t diesel vehicles	26	45	64	119	207	3	296	517	46	28	50	87	95	165	11	16870	29478	21
Heavy duty >3.5t LPG/CNG vehicles	0	0	0	8	13	0	2	4	0	0	0	0	4	7	0	389	680	0
2&4 stroke petrol motorcycles	0	0	0	26	46	1	0	0	0	1	2	3	12	21	1	131	228	0
Total	40	70	100	3959	6918	100	646	1129	100	33	57	100	876	1531	100	80194	140126	100

	PM10			CO			NOx			SOx			VOC			CO2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Part A																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Part B																		
Combustion	0.1	0.3	1	0.2	0.4	4	0.0	0.1	0	0.0	0.0	0	0.0	0.0	8	122.4	213.9	100
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.1	0.3	1	0.2	0.4	4	0.0	0.1	0	0.0	0.0	0	0.0	0.0	8	122.4	213.9	100
Part C																		
Combustion	10.0	17.5	99	4.9	8.6	96	17.2	30.0	100	35.8	62.5	100	0.2	0.4	92	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	10.0	17.5	99	4.9	8.6	96	17.2	30.0	100	35.8	62.5	100	0.2	0.4	92	0.0	0.0	0
Total																		
Combustion	10.1	17.7	100	5.1	9.0	100	17.2	30.0	100	35.8	62.5	100	0.2	0.4	100	122.4	213.9	100
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Total	10.1	17.7	100	5.1	9.0	100	17.2	30.0	100	35.8	62.5	100	0.2	0.4	100	122.4	213.9	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	37	65	8	230	401	4	3	6	0	6	11	5	57	100	4	4797	8381	3
10am-4pm	56	97	13	345	602	5	5	9	1	9	16	8	86	151	6	7195	12572	5
4pm-10pm	228	398	52	1585	2770	24	23	39	3	24	41	20	396	693	26	32528	56837	23
10pm-6am	69	120	16	418	730	6	6	11	1	13	22	10	104	182	7	10066	17589	7
Total	389	680	89	2577	4504	39	37	65	5	52	91	43	644	1126	42	54586	95380	39
Motor Vehicles																		
6am-10am	8	15	2	842	1472	13	137	240	20	7	12	6	186	326	12	17051	29809	12
10am-4pm	18	31	4	1743	3048	27	285	497	41	14	25	12	386	675	25	35311	61732	25
4pm-10pm	12	21	3	1191	2083	18	194	340	28	10	17	8	264	461	17	24132	42189	17
10pm-6am	2	3	0	183	319	3	30	52	4	2	3	1	40	71	3	3701	6470	3
Total	40	70	9	3959	6922	61	646	1130	92	33	57	27	876	1532	58	80194	140200	57
Industry																		
6am-10am	3	4	1	1	2	0	4	8	1	9	16	7	0	0	0	1533	2678	1
10am-4pm	6	11	1	3	6	0	11	19	2	22	39	19	0	0	0	3831	6694	3
4pm-10pm	1	2	0	1	1	0	2	4	0	4	8	4	0	0	0	766	1339	1
10pm-6am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	10	18	2	5	9	0	17	30	2	36	63	30	0	0	0	6130	10711	4
Combined Total																		
6am-10am	48	84	11	1073	1874	16	145	253	21	22	39	18	244	426	16	23380	40849	17
10am-4pm	79	139	18	2091	3654	32	300	525	43	46	81	38	472	825	31	46337	80961	33
4pm-10pm	241	421	55	2777	4853	42	219	383	31	38	66	32	660	1153	43	57427	100336	41
10pm-6am	71	123	16	600	1049	9	36	63	5	14	25	12	145	253	10	13767	24054	10
Total	439	767	100	6542	11430	100	701	1224	100	120	210	100	1521	2657	100	140910	246200	100

Sockburn

	Daily Fuel Quantity			PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg/day	t/day	Use %	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Open fire																					
- Wood	2337	2.3	19	35	133	12	280	1062	20	4	15	17	0	2	1	70	265	20	3974	15041	11
- Coal	3153	3.2	64	104	394	35	189	716	14	5	18	21	57	215	62	47	179	14	8828	33414	26
Pre 1989 Woodburner																					
- Wood	5219	5.2	43	67	253	22	534	2023	38	7	28	33	1	4	1	134	506	38	8872	33579	26
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989-1992 (incl) Woodburner																					
- Wood	1566	1.6	13	11	41	4	86	327	6	1	4	5	0	1	0	22	82	6	2661	10074	8
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post 1993 Woodburner																					
- Wood	2087	2.1	17	12	47	4	99	373	7	1	5	6	0	2	0	25	93	7	3549	13432	10
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enclosed Coal Burner																					
- Wood	544	0.5	4	8	29	3	62	235	4	1	3	4	0	0	0	16	59	4	924	3498	3
- Coal	1812	1.8	36	57	216	19	104	392	7	3	10	11	33	123	36	26	98	7	5074	19204	15
Pot Belly																					
- Wood	399	0.4	3	6	22	2	46	173	3	1	2	3	0	0	0	11	43	3	678	2565	2
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incinerator																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Wood	12151	12.2		138	524	46	1108	4192	79	15	58	68	2	9	3	277	1048	79	20657	78188	60
Total Coal	4965	5.0		161	610	54	293	1108	21	7	28	32	89	338	97	73	277	21	13902	52618	40
Total Gas	445	0.4		0	0		0	1		1	3		0	0		0	0		1113	4213	
Total Oil	93	0.1		0	0		0	0		0	1		0	1		0	0		298	1129	
Total (Wood and Coal only)	17116	17		300	1134	100	1400	5301	100	23	85	100	92	347	100	350	1325	100	34559	13080	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Light duty <3.5t petrol vehicles	12	44	29	3597	13614	90	322	1218	49	2	6	5	737	2789	83	55671	210715	69
Light duty <3.5t diesel vehicles	1	5	3	7	27	0	5	17	1	2	6	5	3	13	0	3321	12572	4
Light duty <3.5t LPG/CNG vehicles	0	0	0	8	29	0	10	37	1	0	0	0	10	36	1	1586	6002	2
Heavy duty >3.5t petrol vehicles	1	5	3	227	859	6	15	55	2	0	0	0	23	86	3	2754	10425	3
Heavy duty >3.5t diesel vehicles	26	98	64	120	453	3	299	1130	46	29	108	87	95	361	11	17012	64391	21
Heavy duty >3.5t LPG/CNG vehicles	0	0	0	8	29	0	2	9	0	0	0	0	4	15	0	392	1486	0
2&4 stroke petrol motorcycles	0	0	0	27	101	1	0	1	0	1	3	3	12	45	1	132	499	0
Total	40	152	100	3992	15112	100	652	2467	100	33	125	100	884	3345	100	80869	306090	100

	PM10			CO			NOx			SOx			VOC			CO2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Part A																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Part B																		
Combustion	16.9	64.0	85	8.2	31.1	84	29.7	112.4	92	61.7	233.6	94	0.4	1.3	4	10642.5	40283.0	100
Other Processes	1.7	6.4	9	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	1.0	3.8	11	0.0	0.0	0
Sub-total	18.6	70.4	94	8.2	31.1	84	29.7	112.4	92	61.7	233.6	94	1.3	5.1	14	10642.5	40283.0	100
Part C																		
Combustion	1.2	4.7	6	1.5	5.8	16	2.4	9.2	8	3.8	14.2	6	0.2	0.7	2	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	7.8	29.5	84	0.0	0.0	0
Sub-total	1.2	4.7	6	1.5	5.8	16	2.4	9.2	8	3.8	14.2	6	8.0	30.2	86	0.0	0.0	0
Total																		
Combustion	18.1	68.6	91	9.7	36.9	100	32.1	121.6	100	65.5	247.8	100	0.5	2.0	6	10642.5	40283.0	100
Other Processes	1.7	6.4	9	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	8.8	33.3	94	0.0	0.0	0
Total	19.8	75.1	100	9.7	36.9	100	32.1	121.6	100	65.5	247.8	100	9.3	35.3	100	10642.5	40283.0	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	16	62	5	101	381	2	1	6	0	3	11	2	25	95	2	2312	8753	2
10am-4pm	72	272	20	309	1168	6	5	19	1	24	92	13	77	292	6	8043	30441	6
4pm-10pm	167	631	46	762	2886	14	12	47	2	53	201	28	191	721	15	19096	72278	15
10pm-6am	44	168	12	229	866	4	4	14	1	12	44	6	57	217	5	5108	19333	4
Total	300	1134	83	1400	5301	26	23	85	3	92	347	48	350	1325	28	34559	130806	27
Motor Vehicles																		
6am-10am	9	34	2	880	3334	16	144	544	20	7	28	4	195	738	16	17830	67539	14
10am-4pm	18	69	5	1803	6831	33	294	1115	42	15	56	8	399	1512	32	36526	138358	28
4pm-10pm	11	42	3	1112	4213	21	182	688	26	9	35	5	246	932	20	22526	85326	18
10pm-6am	2	7	1	197	745	4	32	122	5	2	6	1	44	165	4	3986	15099	3
Total	40	152	11	3992	15123	74	652	2468	92	33	125	17	884	3347	71	80869	306322	63
Industry																		
6am-10am	3	13	1	2	7	0	6	21	1	11	43	6	2	8	0	2510	9500	2
10am-4pm	5	21	2	3	12	0	9	35	1	18	69	10	5	20	0	4546	17207	4
4pm-10pm	5	18	1	2	8	0	8	29	1	16	60	8	1	5	0	2974	11258	2
10pm-6am	6	23	2	3	10	0	10	36	1	20	76	11	0	2	0	3122	11818	2
Total	20	75	6	10	37	0	32	122	5	65	248	34	9	35	1	13152	49784	10
Combined Total																		
6am-10am	29	109	8	983	3719	18	151	571	21	22	82	11	222	841	18	22653	85744	18
10am-4pm	95	361	27	2115	8005	39	309	1168	44	57	217	30	482	1823	39	49115	185906	38
4pm-10pm	183	692	51	1877	7104	35	202	763	29	78	295	41	438	1658	35	44596	168803	35
10pm-6am	53	199	15	428	1621	8	45	171	6	33	126	17	101	383	8	12216	46240	10
Total	360	1361	100	5403	20450	100	706	2674	100	190	720	100	1243	4705	100	128580	486693	100

Spreydon/Addington

	Daily Fuel Quantity			PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg/day	t/day	Use %	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Open fire																					
- Wood	10736	10.7	33	161	216	15	1288	1730	30	18	24	24	2	3	1	322	433	30	18252	24512	16
- Coal	8093	8.1	37	267	359	25	486	652	11	12	16	17	146	196	36	121	163	11	22660	30432	19
Pre 1989 Woodburner																					
- Wood	10359	10.4	32	133	178	12	1061	1425	25	15	20	20	2	3	1	265	356	25	17610	23650	15
- Coal	1012	1.0	5	28	38	3	52	70	1	1	2	2	18	24	5	13	17	1	2832	3804	2
1989-1992 (incl) Woodburner																					
- Wood	5179	5.2	16	36	48	3	286	384	7	4	5	5	1	1	0	71	96	7	8805	11825	8
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post 1993 Woodburner																					
- Wood	5179	5.2	16	31	41	3	244	328	6	3	5	5	1	1	0	61	82	6	8805	11825	8
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enclosed Coal Burner																					
- Wood	1079	1.1	3	15	21	1	123	166	3	2	2	2	0	0	0	31	41	3	1834	2464	2
- Coal	12814	12.8	58	403	541	38	733	984	17	18	25	25	231	310	58	183	246	17	35878	48184	31
Pot Belly																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incinerator																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Wood	32533	32.5		375	504	35	3003	4033	70	41	55	57	7	9	2	751	1008	70	55306	74276	47
Total Coal	21918	21.9		699	938	65	1270	1706	30	32	43	43	395	530	98	318	427	30	61370	82421	53
Total Gas	1628	1.6		0	0		1	1		3	4		0	0		0	0		4070	5467	
Total Oil	1484	1.5		2	3		1	1		3	4		6	8		0	0		4748	6376	
Total (Wood and Coal only)	54451	54		1074	1442	100	4273	5739	100	73	98	100	401	539	100	1068	1435	100	11667	15669	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Light duty <3.5t petrol vehicles	24	32	29	7369	9896	90	659	885	49	3	5	5	1509	2027	83	114046	153165	69
Light duty <3.5t diesel vehicles	3	3	3	14	19	0	9	13	1	3	5	5	7	9	0	6804	9138	4
Light duty <3.5t LPG/CNG vehicles	0	0	0	16	21	0	20	27	1	0	0	0	20	26	1	3249	4363	2
Heavy duty >3.5t petrol vehicles	3	4	3	465	624	6	30	40	2	0	0	0	46	62	3	5643	7578	3
Heavy duty >3.5t diesel vehicles	53	71	64	245	329	3	612	821	46	59	79	87	196	263	11	34851	46805	21
Heavy duty >3.5t LPG/CNG vehicles	0	0	0	16	21	0	5	6	0	0	0	0	8	11	0	804	1080	0
2&4 stroke petrol motorcycles	0	0	0	55	73	1	0	1	0	2	2	3	24	33	1	270	363	0
Total	82	111	100	8179	10984	100	1335	1793	100	67	91	100	1810	2431	100	165667	222491	100

	PM10			CO			NOx			SOx			VOC			CO2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Part A																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Part B																		
Combustion	2.9	3.9	28	1.4	1.8	22	4.9	6.5	22	10.3	13.9	24	0.0	0.1	0	1448.9	1945.8	100
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	5.2	7.0	14	0.0	0.0	0
Sub-total	2.9	3.9	28	1.4	1.8	22	4.9	6.5	22	10.3	13.9	24	5.2	7.0	14	1448.9	1945.8	100
Part C																		
Combustion	7.7	10.4	72	5.0	6.6	78	17.6	23.6	78	33.0	44.3	76	0.5	0.7	1	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	31.2	41.9	84	0.0	0.0	0
Sub-total	7.7	10.4	72	5.0	6.6	78	17.6	23.6	78	33.0	44.3	76	31.7	42.6	86	0.0	0.0	0
Total																		
Combustion	10.7	14.3	100	6.3	8.5	100	22.5	30.2	100	43.4	58.2	100	0.6	0.7	1	1448.9	1945.8	100
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	36.4	48.9	99	0.0	0.0	0
Total	10.7	14.3	100	6.3	8.5	100	22.5	30.2	100	43.4	58.2	100	37.0	49.6	100	1448.9	1945.8	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	76	102	7	236	317	2	4	6	0	35	47	7	59	79	2	7776	10443	3
10am-4pm	133	178	11	504	677	4	9	12	1	52	70	10	126	169	4	15088	20263	5
4pm-10pm	713	958	61	3060	4109	25	51	68	4	245	328	48	765	1027	26	78262	105106	27
10pm-6am	152	204	13	473	635	4	9	12	1	69	93	14	118	159	4	15551	20886	5
Total	1074	1442	92	4273	5739	34	73	98	5	401	539	78	1068	1435	37	116677	156697	40
Motor Vehicles																		
6am-10am	18	24	2	1766	2371	14	288	387	20	15	20	3	391	525	13	35781	48028	12
10am-4pm	37	49	3	3665	4919	29	598	803	42	30	41	6	811	1089	28	74229	99637	25
4pm-10pm	24	32	2	2352	3157	19	384	515	27	19	26	4	521	699	18	47647	63956	16
10pm-6am	4	5	0	395	531	3	65	87	5	3	4	1	88	117	3	8009	10751	3
Total	82	110	7	8179	10978	66	1335	1792	93	67	91	13	1810	2430	62	165667	222372	56
Industry																		
6am-10am	3	4	0	2	2	0	6	8	0	11	15	2	9	12	0	3035	4076	1
10am-4pm	6	8	1	4	5	0	13	18	1	26	35	5	22	30	1	7406	9946	3
4pm-10pm	2	2	0	1	1	0	3	5	0	7	9	1	5	7	0	1699	2281	1
10pm-6am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	11	14	1	6	8	0	22	30	2	43	58	8	37	50	1	12139	16303	4
Combined Total																		
6am-10am	96	130	8	2004	2692	16	298	401	21	60	81	12	459	617	16	46591	62570	16
10am-4pm	176	236	15	4173	5604	33	620	833	43	108	146	21	960	1289	33	96723	129895	33
4pm-10pm	739	992	63	5413	7270	43	438	588	31	271	364	53	1291	1734	44	127608	171372	43
10pm-6am	156	209	13	868	1166	7	74	99	5	73	98	14	206	276	7	23561	31641	8
Total	1167	1567	100	12458	16731	100	1431	1921	100	512	687	100	2915	3915	100	294483	395479	100

St Albans

	Daily Fuel Quantity			PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg/day	t/day	Use %	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Open fire																					
- Wood	29735	29.7	36	446	516	36	3568	4131	44	49	57	41	6	7	3	892	1033	44	50549	58526	30
- Coal	8705	8.7	100	287	333	23	522	605	6	13	15	11	157	181	90	131	151	6	24373	28219	15
Pre 1989 Woodburner																					
- Wood	26740	26.7	32	342	396	27	2738	3170	33	38	44	32	5	6	3	685	793	33	45458	52632	27
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989-1992 (incl) Woodburner																					
- Wood	11460	11.5	14	79	92	6	633	732	8	9	10	7	2	3	1	158	183	8	19482	22557	12
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post 1993 Woodburner																					
- Wood	15280	15.3	18	90	104	7	721	835	9	10	11	8	3	4	2	180	209	9	25976	30076	16
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enclosed Coal Burner																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pot Belly																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incinerator																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Wood	83215	83.2		958	1109	77	7660	8869	94	105	122	89	17	19	10	1915	2217	94	14146	16379	85
Total Coal	8705	8.7		287	333	23	522	605	6	13	15	11	157	181	90	131	151	6	24373	28219	15
Total Gas	7884	7.9		1	1		3	4		16	18		0	0		2	2		19709	22820	
Total Oil	0	0.0		0	0		0	0		0	0		0	0		0	0		0	0	
Total (Wood and Coal only)	91920	92		1245	1441	100	8182	9474	100	118	137	100	173	201	100	2046	2368	100	16583	19200	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Light duty <3.5t petrol vehicles	26	30	29	7874	9117	90	704	815	49	4	4	5	1613	1867	83	121872	141104	69
Light duty <3.5t diesel vehicles	3	3	3	15	18	0	10	12	1	4	4	5	7	8	0	7271	8419	4
Light duty <3.5t LPG/CNG vehicles	0	0	0	17	20	0	21	25	1	0	0	0	21	24	1	3472	4019	2
Heavy duty >3.5t petrol vehicles	3	3	3	497	575	6	32	37	2	0	0	0	50	57	3	6030	6981	3
Heavy duty >3.5t diesel vehicles	57	66	64	262	303	3	654	757	46	63	73	87	209	242	11	37242	43119	21
Heavy duty >3.5t LPG/CNG vehicles	0	0	0	17	19	0	5	6	0	0	0	0	9	10	0	859	995	0
2&4 stroke petrol motorcycles	0	0	0	58	68	1	0	1	0	2	2	3	26	30	1	289	334	0
Total	88	102	100	8740	10119	100	1427	1652	100	72	83	100	1934	2240	100	177034	204972	100

	PM10			CO			NOx			SOx			VOC			CO2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Part A																		
Combustion	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Part B																		
Combustion	0.0	0.1	1	0.1	0.1	2	0.5	0.5	3	0.7	0.8	2	0.0	0.0	1	527.6	610.9	100
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
Sub-total	0.0	0.1	1	0.1	0.1	2	0.5	0.5	3	0.7	0.8	2	0.0	0.0	1	527.6	610.9	100
Part C																		
Combustion	7.4	8.6	99	4.9	5.7	98	16.9	19.5	97	31.2	36.1	98	0.5	0.6	16	0.0	0.0	0
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	2.6	3.0	83	0.0	0.0	0
Sub-total	7.4	8.6	99	4.9	5.7	98	16.9	19.5	97	31.2	36.1	98	3.1	3.6	99	0.0	0.0	0
Total																		
Combustion	7.4	8.6	100	5.0	5.8	100	17.3	20.1	100	31.9	36.9	100	0.5	0.6	17	527.6	610.9	100
Other Processes	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	2.6	3.0	83	0.0	0.0	0
Total	7.4	8.6	100	5.0	5.8	100	17.3	20.1	100	31.9	36.9	100	3.1	3.6	100	527.6	610.9	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	115	133	9	793	918	5	11	13	1	13	15	5	198	230	5	15916	18427	4
10am-4pm	172	200	13	1189	1377	7	17	20	1	19	22	7	297	344	7	23873	27641	7
4pm-10pm	870	1007	65	5499	6367	32	80	93	5	140	162	50	1375	1592	35	111847	129498	32
10pm-6am	88	101	7	701	812	4	10	11	1	2	2	1	175	203	4	14202	16443	4
Total	1245	1441	93	8182	9474	48	118	137	8	173	201	63	2046	2368	51	165838	192009	47
Motor Vehicles																		
6am-10am	19	22	1	1881	2177	11	307	355	20	16	18	6	416	482	10	38107	44105	11
10am-4pm	39	45	3	3872	4481	23	632	731	40	32	37	12	857	992	22	78427	90772	22
4pm-10pm	26	30	2	2552	2954	15	417	482	27	21	24	8	565	654	14	51692	59829	15
10pm-6am	4	5	0	435	503	3	71	82	5	4	4	1	96	111	2	8809	10195	2
Total	88	102	7	8740	10116	52	1427	1651	91	72	83	26	1934	2239	49	177034	204901	50
Industry																		
6am-10am	2	2	0	1	1	0	4	5	0	8	9	3	1	1	0	2766	3203	1
10am-4pm	5	5	0	3	4	0	11	12	1	20	23	7	2	2	0	6850	7931	2
4pm-10pm	1	1	0	1	1	0	2	3	0	4	5	1	0	0	0	1449	1678	0
10pm-6am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	7	9	1	5	6	0	17	20	1	32	37	11	3	4	0	11066	12813	3
Combined Total																		
6am-10am	136	157	10	2675	3098	16	323	374	21	36	42	13	615	713	15	56789	65753	16
10am-4pm	216	250	16	5064	5864	30	660	764	42	71	82	26	1156	1339	29	109150	126379	31
4pm-10pm	896	1038	67	8052	9323	48	499	578	32	165	191	59	1940	2246	49	164988	191031	47
10pm-6am	92	107	7	1136	1315	7	81	93	5	5	6	2	272	314	7	23010	26643	7
Total	1340	1552	100	16928	19599	100	1562	1809	100	277	321	100	3983	4612	100	353938	409805	100

Wigram

	Daily Fuel Quantity			PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg/day	t/day	Use %	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Open fire																					
- Wood	581	0.6	19	9	11	12	70	89	21	1	1	18	0	0	1	17	22	21	987	1256	11
- Coal	783	0.8	64	26	33	36	47	60	14	1	1	22	14	18	62	12	15	14	2192	2791	26
Pre 1989 Woodburner																					
- Wood	1037	1.0	34	13	17	18	106	135	32	1	2	27	0	0	1	27	34	32	1763	2244	21
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989-1992 (incl) Woodburner																					
- Wood	389	0.4	13	3	3	4	21	27	6	0	0	5	0	0	0	5	7	6	661	841	8
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post 1993 Woodburner																					
- Wood	778	0.8	26	5	6	6	37	47	11	1	1	9	0	0	1	9	12	11	1322	1683	15
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enclosed Coal Burner																					
- Wood	135	0.1	4	2	2	3	15	20	5	0	0	4	0	0	0	4	5	5	230	292	3
- Coal	450	0.5	36	14	18	20	26	33	8	1	1	12	8	10	36	6	8	8	1260	1604	15
Pot Belly																					
- Wood	99	0.1	3	1	2	2	11	14	3	0	0	3	0	0	0	3	4	3	168	214	2
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incinerator																					
- Wood	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Coal	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Wood	3018	3.0		33	41	45	261	332	78	4	5	66	1	1	3	65	83	78	5130	6530	60
Total Coal	1233	1.2		40	51	55	73	93	22	2	2	34	22	28	97	18	23	22	3452	4395	40
Total Gas	111	0.1		0	0		0	0		0	0		0	0		0	0		276	352	
Total Oil	23	0.0		0	0		0	0		0	0		0	0		0	0		74	94	
Total (Wood and Coal only)	4251	4		73	92	100	333	424	100	5	7	100	23	29	100	83	106	100	8582	10925	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Light duty <3.5t petrol vehicles	10	13	23	2009	2557	85	500	637	50	1	2	3	569	725	84	67901	86432	69
Light duty <3.5t diesel vehicles	2	2	3	9	11	0	6	7	1	2	3	5	4	5	1	4051	5157	4
Light duty <3.5t LPG/CNG vehicles	0	0	0	6	7	0	12	15	1	0	0	0	11	14	2	1934	2462	2
Heavy duty >3.5t petrol vehicles	2	2	4	217	277	9	30	38	3	0	0	0	22	28	3	3359	4276	3
Heavy duty >3.5t diesel vehicles	30	38	69	70	89	3	453	577	45	34	43	88	56	71	8	20750	26412	21
Heavy duty >3.5t LPG/CNG vehicles	0	0	0	9	12	0	3	4	0	0	0	0	5	6	1	479	609	0
2&4 stroke petrol motorcycles	0	0	0	33	41	1	0	0	0	1	1	3	15	18	2	161	205	0
Total	44	56	100	2352	2994	100	1004	1278	100	38	48	100	682	868	100	98635	125553	100

	PM10			CO			NOx			SOx			VOC			CO2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Part A																		
Combustion	0.2	0.2	1	0.8	1.0	7	3.2	4.1	8	1.9	2.4	3	0.2	0.2	1	3603.3	4586.4	66
Other Processes	0.2	0.3	1	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	18.7	23.8	57	0.0	0.0	0
Sub-total	0.4	0.5	2	0.8	1.0	7	3.2	4.1	8	1.9	2.4	3	18.8	24.0	57	3603.3	4586.4	66
Part B																		
Combustion	0.2	0.2	1	0.4	0.5	3	1.6	2.0	4	2.3	2.9	3	0.1	0.1	0	1831.5	2331.2	34
Other Processes	0.2	0.3	1	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	7.8	10.0	24	0.0	0.0	0
Sub-total	0.4	0.5	2	0.4	0.5	3	1.6	2.0	4	2.3	2.9	3	7.9	10.1	24	1831.5	2331.2	34
Part C																		
Combustion	18.3	23.3	94	10.6	13.5	90	35.9	45.7	88	70.6	89.9	94	0.8	1.0	2	0.0	0.0	0
Other Processes	0.5	0.6	2	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	5.2	6.6	16	0.0	0.0	0
Sub-total	18.7	23.9	96	10.6	13.5	90	35.9	45.7	88	70.6	89.9	94	6.0	7.6	18	0.0	0.0	0
Total																		
Combustion	18.6	23.7	95	11.8	15.0	100	40.7	51.8	100	74.8	95.2	100	1.1	1.4	3	5434.7	6917.6	100
Other Processes	0.9	1.2	5	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	31.7	40.3	97	0.0	0.0	0
Total	19.5	24.9	100	11.8	15.0	100	40.7	51.8	100	74.8	95.2	100	32.8	41.7	100	5434.7	6917.6	100

	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Home Heating																		
6am-10am	4	5	3	24	30	1	0	0	0	1	1	1	6	8	1	574	731	0
10am-4pm	18	22	13	75	95	3	1	2	0	6	8	4	19	24	2	1997	2542	2
4pm-10pm	40	51	30	180	230	7	3	4	0	13	17	10	45	57	6	4742	6037	4
10pm-6am	11	14	8	54	69	2	1	1	0	3	4	2	14	17	2	1269	1615	1
Total	73	92	53	333	424	12	5	7	1	23	29	17	83	106	10	8582	10925	7
Motor Vehicles																		
6am-10am	10	12	7	517	658	19	221	281	21	8	11	6	150	191	19	21685	27589	17
10am-4pm	20	25	15	1061	1350	39	453	576	43	17	22	13	308	391	39	44507	56625	34
4pm-10pm	12	16	9	660	840	24	282	359	27	11	14	8	191	243	24	27688	35227	21
10pm-6am	2	3	2	113	144	4	48	62	5	2	2	1	33	42	4	4754	6049	4
Total	44	56	32	2352	2992	87	1004	1277	96	38	48	28	682	867	85	98635	125489	75
Industry																		
6am-10am	5	6	4	3	4	0	10	13	1	19	24	14	8	10	1	5847	7442	4
10am-4pm	12	15	9	7	9	0	24	31	2	46	59	34	17	22	2	13491	17172	10
4pm-10pm	3	3	2	2	2	0	6	8	1	10	13	7	7	9	1	4050	5156	3
10pm-6am	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	20	25	14	12	15	0	41	52	4	75	95	55	33	42	4	23388	29770	18
Combined Total																		
6am-10am	18	23	14	544	692	20	231	294	22	28	35	20	164	209	21	28106	35775	22
10am-4pm	49	63	36	1143	1455	42	479	609	46	69	88	51	343	437	43	59995	76364	46
4pm-10pm	55	70	41	842	1072	31	291	370	28	34	43	25	244	310	31	36481	46435	28
10pm-6am	13	16	9	168	214	6	49	63	5	5	6	3	46	59	6	6023	7666	5
Total	136	173	100	2697	3433	100	1050	1336	100	136	173	100	798	1015	100	130606	166240	100

Appendix IV - Classification of Part A, B, and C Industries

Activity	Description	Classification
Combustion Processes Incinerators, boilers - burning of fossil fuels, including flaring or incineration of trade wastes or refuse, which singly or together can be used to burn combustible matter.	• heat release > 50MW • rate > 100kg/hr where pathological, refuse, or trade wastes are incinerated. • heat release > 500KW where products used to, stove enamel, bake or dry releasing dust or other pollutants, or maintaining reducing conditions in any manufacturing process. • where combustible matter is incinerated in excess of 100kg/hr containing *sulphur, arsenically treated wood, rubber, oil sludge, pitch or paint residues.* • where combustible matter is incinerated in excess of 25kg/hr which contains *chemicals, plastics, or fibre in which fluorine, chlorine, phosphorous, or nitrogen has been chemically combined.*	Part A
	• heat release between 5MW-50MW • for recovery of metals from insulated cable, motor vehicles, other mixtures, combinations of metals and combustibles. • for cleaning of drums or containers. • for frost protection on more than one occasion in one year by the use of fire pots. • rate < 100kg/hr where pathological, refuse or trade wastes are incinerated. • where combustible matter is incinerate between 25-100kg/hr containing *sulphur, arsenically treated wood, rubber, oil sludge, pitch, or paint residues.* • where combustible matter is incinerated between 5-25kg/hr which contains *chemicals, plastics or fibre in which fluorine, chlorine, phosphorus, or nitrogen has been chemically combined.*	Part B
	• heat release between 40kW and 5MW	Part C
Coffee Roasting Processes **Vegetable Frying Processes**	• Raw material capacity > 5 tonnes/hr for deep fat frying, oil frying, curing by smoking.	Part A
	• Raw material capacity < 5 tonnes/hr.	Part C
Quarries The extraction of minerals from the surface of the ground or from an open pit (including coal, coke, and carbon), or the size reduction of such minerals, or the storage outside and above the ground, or their drying or heating that releases dust or any other air pollutant.	• an open cast mine producing > 100 tonnes/hr • a size reduction or screening plant with capacity >200 tonnes/hr • a storage capacity >10,000 tonnes. • heat release > 2,000kW • are part of a manufacturing process for Portland or similar cements and pozzolanic materials. • part of the manufacturing process for the sintering, calcining, or roasting of metal ores in preparation for burning or smelting. • for making hot-mix asphalt paving mixes. • Part of the process for making glass or frit from raw materials or making mineral wood or glass fibre, including application of any surface coasting to the fibres.	Part A

	• an opencast extraction process between 5-100 tonnes/hr. • a size reduction or screening plant with capacity between 5-200 tonnes/hr. • a storage capacity between 500 - 10,000 tonnes. • rate of heat release < 2,000 kW.	Part B
Wood Processing Industries Any industrial wood pulp or particle board processes	• wood or other cellulose material is cooked with chemical solutions to dissolve lignin and the associated processes of bleaching and chemical by-product recovery. • Hard board or particle board or wood pulp are made by processes involving emission of air pollutants.	Part A
Abrasive Blasting	• Any dry abrasive blasting	Part B
	• Any wet abrasive blasting	Part C
Wool scours and Tanneries, Freezing Works and Abattoirs All industrial animal processing, which have a raw material capacity:	1. > 0.5 of a tonne/hr, including processes for rendering or reduction or drying through the application of heat to animal matter (eg. Feathers, blood, bone, hoof, skin, offal, whole fish, fish heads, fish guts and parts and organic manures). 2. > 5 tonnes/hr including processes for deep fat frying, oil frying, curing by smoking, roasting of berries or grains, or where organic matter including wood is subject to such temperatures or conditions that there is partial distillation or pyrolysis. • 2 tonnes an hour for processes for the drying of milk. • cheese manufacture	Part A
	• < 0.5 of a tonne/hr for processes described in 1. Above. • Between 250 kg/hr - 5 tonnes/hr for processes in 2. above. • <2 tonnes per hour for processes for the drying of milk.	Part B
	• any process of wool scouring	Part B
	• any of the above having a raw material capacity of <250kg/hr.	Part C
Concrete Manufacturing Plants	• extraction, size reduction, screening, storage (outside and above ground), drying or heating releasing dust or other air pollutant involved with the manufacturing process for Portland or similar cements and pozzolanic materials.	Part A therefore requires a resource consent.
Industrial Metallurgical Processes (Including associated foundry practices)	• the extraction (including Electro-chemcial methods of reduction) of any metal or metal alloy form its ore, oxide or other compound. • the making of steel or the refining of any metal or modification of any alloy in the molten state by blowing with air, oxygen, oxygen enriched air, chlorine or other gasses, or by addition of reactive chemicals or volatile fluxes and the use of oxygen lancing in scarfing and similar operations. • The manufacture of silicon or ferrosilicon or of metal powders or of alloys rich in any metals specified in clauses 1 to 3. • The melting of any metal or metal alloy, including secondary melting and the seating of scrap metal, where aggregated melting capacity exceeds one tonne an hour. • hot dip galvanising or other processes for the protection of surfaces by metal coating using fluxes.	Part A

Industrial or Chemical Process having as a by-product or emission of any substance that can cause air pollution, including any processes used in (excluding electroplating):	• Bodying of natural oils or manufacture or reaction of monomers for production of *synthetic resins, varnishes* and *plastics*. • Production of soap, grease, detergents, and surface active agents. • -Synthesis or extraction of organic chemicals including formulation of *insecticides*, *weedicides*, *plant hormones*, and like *toxic* or *offenisve organic compounds*. • Production of *phosphatic* or *nitrogenuous* synthetic fertilisers, including granulation of single or mixed fertilisers. • Any chemical manufacturing process using or producing *chlorine* (except for water sterilisation) at rates exceeding 5kg/hr. • separation of concentration for manufacture or disposal of any *uranium metal* or compound or any *radioactive substance*.	Part A
Industrial carbonising or gasification processes in which natural gas, petroleum, shale, coal, wood, or other carbonaceous material is subject to:	• Pyrolysis, carbonisation, or destructive distillation, the soild or gaseous products being recovered. • Gasification by partial combustion with air or oxygen or reaction with steam.	Part A
Processes involving the production of **Compost.**	• From raw materials that contain municipal or domestic refuse with a raw materials capacity 10 tonnes per day. • From raw materials that do not contain municipal or domestic refuse and which has on the premises at any time a volume of compost and raw materials exceeding 750 cubic metres.	Part A
	• from raw materials containing municipal or domestic refuse with a raw material capacity < 10 tonnes/day. • from raw materials not containing municipal or domestic refuse with a volume at any one time of between 100-750 m^3 on the premises.	Part B
	• (except silage) from raw materials that do not contain municipal or domestic waste with a volume at any one time of < 100 m^3 on the premises.	Part C.
Use of **geothermal steam**	• at a rate of 5MW.	Part A
Industrial or trade processes, e.g., **spray painting**	• using isocyanates at a rate > 100kg/hr. • organic plasticsers at a rate > 100kg/hr.	Part A
	• using di-isocyanates at a rate < 100kg/hr	Part B
Activities **owned or operated by a local authority** where the process is situated within the area administered by that local authority.	• Any process/activity specified as a part B process.	Part A
Fellmongery Process	• using sulphides • treating fellmongery liquid wastes containing sulphides.	Part A
General - Any industrial or trade	• Grain elevators, seed dressing but not processes solely concerned with retail distribution or with distribution of	Part B

process not described in the schedule for blending, packaging or handling of air polluting substances specified in the First Schedule including:	fuels.	
Dag Crushing	• Any industrial or trade processes for the teasing of textiles, shredding of paper, for cleaning sacks, or the crushing or separating dags from wool.	Part B
Umbrella Clause (C7) for almost all activities not covered elsewhere in the Schedules which release fumes or odours that were on the list of air pollutants. E.g., Spray painting, adhesive spraying, chlorinators, furniture strippers, welding.	• Any industrial or trade process not otherwise specified that discharges hydrocarbons or related substances in quantity > 5kg/hr. • any process not otherwise specified above for which a lower emission rate is not specified by which may discharge any of the contaminants in The First Schedule.	Part C
Pneumatic Conveying used in any industrial or trade process.	• of any air polluting substance specified in The First Schedule.	Part C

Appendix V - Process Emission Factors

All process emissions factors were taken from AP42 and WHO and have been allocated a reference (where it exists) under the Standard Industrial Classification (SIC) system, developed by UN in 1989. Where emissions were given in total suspended particulate (TSP), the assumption was made that PM_{10} = 0.4 TSP. This was based on particle sizing work conducted for various emissions of particulate from various industrial processes.

For the individual processes, please note the following:

- Firstly, not all industries produce process air emissions - any process emissions may be to water or solid waste or the industry may have combustion-only air emissions.

- For foundries involved with only melting / casting operations (ref 371)
  Assuming uncontrolled induction furnace
  => EF = 0.05 kg TSP = 0.02 kg PM_{10} per tonne metal product

- For incinerators burning hospital/pathological waste (ref 920) assume uncontrolled incineration
  Assuming the density of waste = 300 kg/m^3 for conversion to tonnes
  => EF = 8.0 kg TSP = 3.2 kg PM_{10} per tonne waste
  => EF = 3.0 kg NO_x per tonne waste

- For industries involved with surface coatings/painting (ref 0)
  Assuming the density of paint = 1 kg/l for conversion to tonnes
  => EF = 560 kg VOC per tonne paint consumed/applied

- For production of resins/adhesives/fibreglass (ref 3513)assume partial vapour recovery
  Assuming partial vapour recovery
  => EF = 3.0 kg VOC per tonne chemical produced

- For fish processing (ref 3114)
  Assuming average emissions
  => EF = 3.0 kg TSP = 1.2 kg PM_{10} per tonne processed fish

- For bitumen plants (ref 354)
  Assuming a dryer drum hot mix process with a cyclone
  => EF = 0.85 kg TSP = = 0.34 kg PM_{10} per tonne produced

- For timber treatment plants (ref 0)
  Assuming average surface coating operation
  => EF = 600 kg VOC per tonne treatment chemical used

- For can manufacturing (ref 372)
  Assuming same emissions as galvanising
  => EF = 2.5 kg TSP = per 1.0 kg PM_{10} tonne plate used

- For fertiliser production (ref 3512)
  Assuming normal superphosphate process

=> EF = 0.76 kg TSP = 0.30 kg PM_{10} per tonne fertiliser produced

We also have to include the emissions from the sulphuric acid manufacture
Assuming stoichiometry H_2S0_4 required is 40% of fertiliser produced
=> EF = 2.4 kg SO_x per tonne H_2SO_4
Therefore overall emissions for the process are
=> EF = 0.76 kg TSP = 0.30 kg PM_{10} per tonne fertiliser produced
=> EF = 0.96 kg SO_x per tonne fertiliser produced

- For textile manufacturing (ref 321)
  Assuming half of the product is printed
  => EF = 71 kg VOC per tonne fabric

- For ready-mix concrete (ref 3699)
  Assuming uncontrolled
  => EF = 0.05 kg TSP = 0.02 kg PM_{10} per tonne concrete produced

- For cable manufacturing (ref 3513)
  Assuming emissions come from plastic cable coating only
  => EF = 1.5 kg TSP = 0.6 kg PM_{10} per tonne plastic used
  => 0.35 kg VOC per tonne plastic used

  Assuming the plastic makes up 10% of the raw materials used, overall emissions are
  => EF = 0.06 kg PM_{10} per tonne cable produced
  => EF = 0.035 kg VOC per tonne cable produced

- For brewing (ref 3133)
  Assuming the density of beer = 1000 kg/m^3 for conversion to tonnes
  => EF = 0.8kg TSP = 0.32 kg PM_{10} per m^3 beer produced
  => EF = 0.25 kg VOC per m^3 beer produced

- For manufacture of chemicals (ref 351)
  Assuming an average emission rate and the density of liquid products = 1 kg/l
  => EF = 0.3 kg TSP = 0.12 kg PM_{10} per tonne product

Appendix VI - Aircraft Emissions

Christchurch International Airport Aircraft Emission

Aircraft Type	Pollutant																	
	PM_{10}			CO			NO_x			SO_x			VOC			CO_2		
	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total	kg	g/ha	% Total
Domestic	6.7	3.2	96	449.3	215.2	96	171.8	82.3	96	19.2	9.2	96	81.6	39.1	96	59959.7	28721.5	96
International	0.3	0.1	4	18.7	9.0	4	7.2	3.4	4	0.8	0.4	4	3.4	1.6	4	2498.3	1196.7	4
Total	7.0	3.4	100	468.0	224.2	100.0	179.0	85.7	100	20.0	9.6	100	85.0	40.7	100	62458.0	29918.2	100

Pollutant emissions produced at different times of a typical winter's day from domestic aircraft - Airport suburb

Pollutant	6am-10am			10am-4pm			4pm-10pm			10pm-6am			Total		
	kg	g/ha	%total	kg	g/ha	%total	kg	g/ha	%total	kg	g/ha	%total	kg	g/ha	%total
PM_{10}	1.5	0.7	23	2.3	1.1	34	2.3	1.1	34	0.6	0.3	9	6.7	3.2	100
CO	102.7	49.2	23	154.0	73.8	34	154.0	73.8	34	38.5	18.4	9	449.3	215.2	100
NO_x	39.3	18.8	23	58.9	28.2	34	58.9	28.2	34	14.7	7.1	9	171.8	82.3	100
SO_x	4.4	2.1	23	6.6	3.2	34	6.6	3.2	34	1.6	0.8	9	19.2	9.2	100
VOC	18.7	8.9	23	28.0	13.4	34	28.0	13.4	34	7.0	3.4	9	81.6	39.1	100
CO_2	13705.1	6564.9	23	20557.6	9847.4	34	20557.6	9847.4	34	5139.4	2461.8	9	59959.7	28721.5	100

Pollutant emissions produced at different times of a typical winter's day from international aircraft - Airport suburb

	6am-10am			10am-4pm			4pm-10pm			10pm-6am			Total		
	kg	g/ha	%total	kg	g/ha	%total	kg	g/ha	%total	kg	g/ha	%total	kg	g/ha	%total
PM_{10}	0.1	0.0	23	0.1	0.0	34	0.1	0.0	34	0.0	0.0	9	0.3	0.1	100
CO	4.3	2.0	23	6.4	3.1	34	6.4	3.1	34	1.6	0.8	9	18.7	9.0	100
NO_x	1.6	0.8	23	2.5	1.2	34	2.5	1.2	34	0.6	0.3	9	7.2	3.4	100
SO_x	0.2	0.1	23	0.3	0.1	34	0.3	0.1	34	0.1	0.0	9	0.8	0.4	100
VOC	0.8	0.4	23	1.2	0.6	34	1.2	0.6	34	0.3	0.1	9	3.4	1.6	100
CO_2	571.0	273.5	23	856.6	410.3	34	856.6	410.3	34	214.1	102.6	9	2498.3	1196.7	100

Pollutant emissions produced at different times of a typical winter's day from all aircraft (domestic and international) - Airport suburb

	6am-10am			10am-4pm			4pm-10pm			10pm-6am			Total		
	kg	g/ha	%total	kg	g/ha	%total	kg	g/ha	%total	kg	g/ha	%total	kg	g/ha	%total
PM_{10}	1.6	0.8	23	2.4	1.1	34	2.4	1.1	34	0.6	0.3	9	7.0	3.4	100
CO	107.0	51.2	23	160.5	76.9	34	160.5	76.9	34	40.1	19.2	9	468.0	224.2	100
NO_x	40.9	19.6	23	61.4	29.4	34	61.4	29.4	34	15.3	7.3	9	179.0	85.7	100
SO_x	4.6	2.2	23	6.9	3.3	34	6.9	3.3	34	1.7	0.8	9	20.0	9.6	100
VOC	19.4	9.3	23	29.1	14.0	34	29.1	14.0	34	7.3	3.5	9	85.0	40.7	100
CO_2	14276.1	6838.5	23	21414.2	10257.7	34	21414.2	10257.7	34	5353.5	2564.4	9	62458.0	29918.2	100